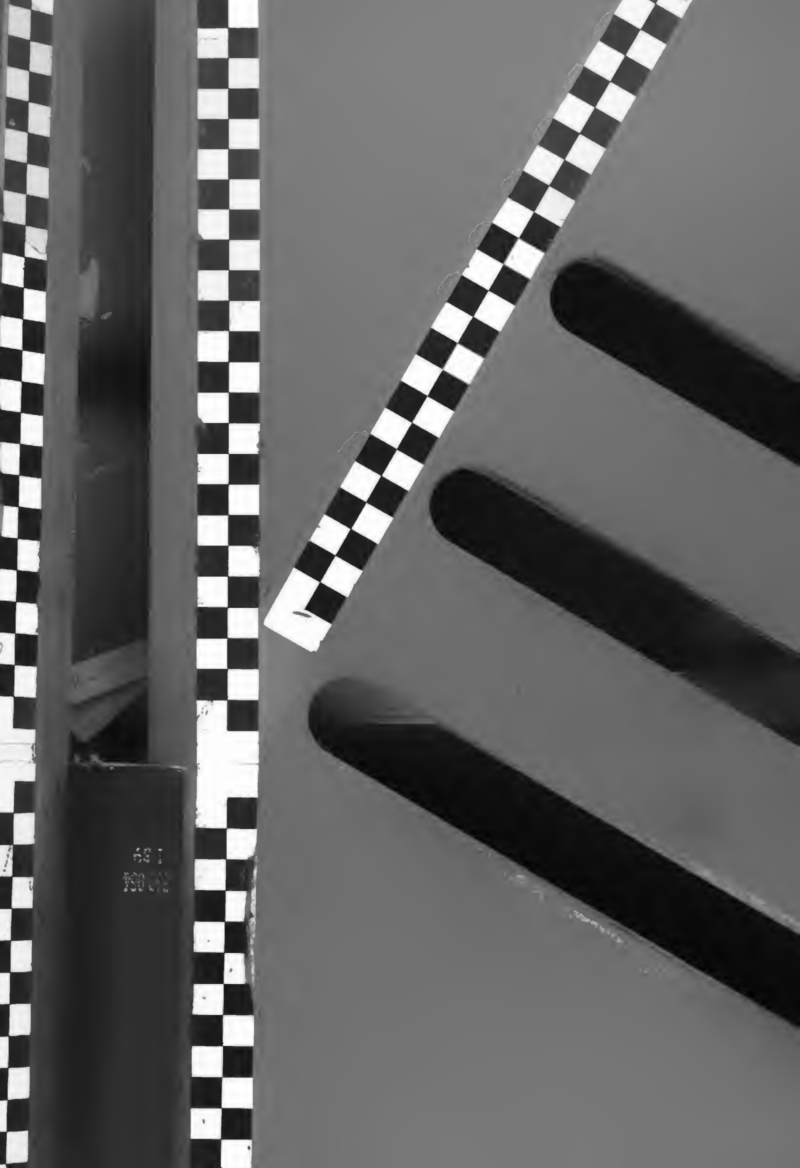
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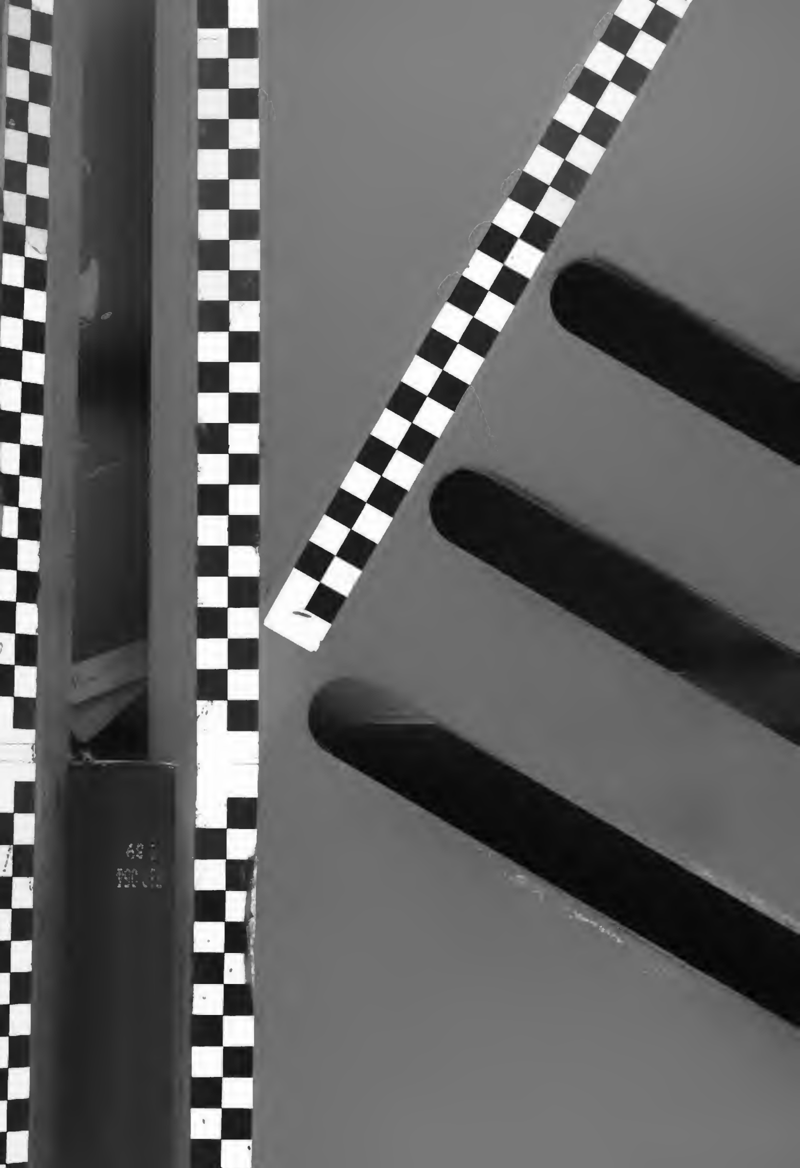

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Vol. III, Part 1.

UPPER TRIASSIC CEPHALOPODA FAUNÆ OF THE HIMÁLAYA.

By Dr. EDMUND MOJSISOVICS, EDLEM VON MOJSVÁR,
Member, Imperial Academy of Science, Vice-Director, K. K. Geologische Reichsanstalt, Vienna.

TRANSLATED BY
DR. ARTHUR H. FOORD, F.S.G., AND MRS. A. H. FOORD.

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HIMÁLAYAN FOSSILS.

VOLUME III, PART 1.

UPPER TRIASSIC CEPHALOPODA FAUNÆ OF THE HIMALAYA.

BY

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Translated[1] *by*

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INTRODUCTION.

In the preliminary communication on the Cephalopod Faunæ of the trias of the Himálaya,[2] published four years ago, the reasons were given which induced the Imperial Academy of Vienna to suggest to the Geological Survey of India the promotion of a special expedition to the Himálaya for the collection of trias fossils, and to participate therein by sending as their representative Dr. Carl Diener, to whom a considerable grant was made from the Boué fund of the Academy. The Imperial Indian Government sanctioned a sum slightly exceeding that given by the Academy for the expenses incurred by Dr. Diener, and ordered Messrs. C. L. Griesbach and C. S. Middlemiss, of the Geological Survey of India, to join the expedition. The success of the expedition was in this manner assured, and on May 27th, 1892, the journey from Naini Tál to the mountains was begun. The participation of Mr. Griesbach, who was placed in official charge of the expedition, was of great assistance, and the remarkable results arrived at are due to his great local knowledge, capacity and energy, and not less to the skill and perseverance of Dr. Diener, whose familiarity with high mountains, gained in his numerous tours in the European Alps, was of invaluable help. The expedition which, in order to reach the region of their work, on the north side of the mountains, had to cross the principal chain of the Himálaya on their journey going and returning, came back to their starting place in Naini Tál on October 7th.

Besides Dr. Diener's detailed account, presented to the Academy and published in the memoirs of the Academy[3] under the title "Ergebnisse einer geologischen Expedition in den Central Himálaya von Johar, Hundes und Painkhanda," there are several smaller communications by Dr. Diener on the particulars of the journey, on geographical conditions and on glacial phenomena,[1] to which references are here given to avoid repetition.

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[1] The German original was published in Vol. LXIII. of the Denkschriften der Kais. Akademie der Wissenschaften in Wien, 1896.

[2] Sitzungsber. d. mathem.-naturw. Cl. Bd. CI. Abth. I, p. 373.

Bd. LXII. (1895), pp. 583-608.

The results of the expedition were very satisfactory, though, on account of the shortness of the time, the original plans could not all be carried out. The rich collections of fossils which were made in some favourable places enable us now to look deeper into the character of the individual faunæ, especially those of the triassic and jurassic periods.

The great bulk of the material of the Dinaric and Scythian series was the cause of my abandoning my original plan to work up all the cephalopod faunæ of Himálayan trias, after having found a thoroughly able worker for the Cephalopoda of the above-named series in Dr. Diener,[2] who worked indefatigably in collecting. I was then able to confine myself to the investigation of the upper triassic Cephalopoda of the Tyrolese and the Bajuvarian Series, which is especially interesting as it represents, for the most part, completely new material.

The first discoveries of Cephalopoda in the trias system of the Himálaya were made at a time when valid distinctions in Cephalopod horizons in our Alps could not yet be made, when the species of Cephalopoda later recognized as peculiar to the Muschelkalk were attributed to the Buntsandstein, and when the definition of species was still so extraordinarily comprehensive that the latter often reached the rank of the genera of the present day; sometimes, as, for example, in "*Ammonites Aon*" even over-stepping it. It is therefore not surprising that the first interpretations of the triassic Ammonites of the Himálaya did not rise above general statements, and that the designations of the species, according to the knowledge of that time, gave the widest latitude to the author's own conceptions. Nevertheless it must be regarded as an advancement in knowledge that the considerable analogies existing between the triassic faunæ of the Himálaya and those of the Alps should have found their expression in a parallelism with the Alpine formations. It must even be admitted that, according to the state of knowledge at the time, the allocation of the fossil-bearing triassic limestone of the Rajhoti Pass in Niti to the upper Alpine trias was perfectly justifiable. The credit of the discovery of these first Himálayan trias fossils is due to Captain (afterwards General) R. Strachey, who published[3] in the year 1851 an account of his geological investigations in the neighbourhood of the Niti Pass. Ed. Suess, who in the year 1862 had an opportunity of seeing the Strachey Collection in London, drew attention to the great similarity of some of its forms to Alpine species[4] and pointed out the importance of the above account. The descriptions and figures were then made by J. W. Salter and published in association with H. F. Blanford in the "Palæontology of

---

[1] Verhandl. der Gesellschaft für Erdkunde in Berlin, 1893, Nr. 6, Zeitschrift des deutschen und österreichischen Alpenvereines, 1895, pp. 269-314, and Mittheilungen der k. k. Geographischen Gesellschaft in Wien, 1896, pp. 1-35.

[2] Dr. Diener has in the meantime finished the working out of the Cephalopod faunæ put into his hands, and the fauna of the Muschelkalk (Anisic Stage) has already appeared (Palæont. Indica, ser. XV., Himálayan Fossils, Vol. II, Trias, Part 2). The faunæ of the Scythian Series is in the press.

[3] Quarterly Journ. Geol. Soc., London, 1851, pp. 292-310.

[4] Jahrb. d. geol. Reichsanst., 1861-62, Verh. p. 258.

Niti in the Northern Himálaya."[1] My distinguished countryman, Ferd. Stoliczka, who, in 1864, accompanied by F. R. Mallet, travelled through Spiti, and has in his well-known memoir[2] given a detailed description of the fossils collected in the so-called "Lilang Series", declared this series to be likewise upper triassic on the ground of the above observations, and pronounced them to be the equivalent of the Hallstatt and St. Cassian beds. A number of the fossils mentioned by Stoliczka are identical with the species described by Salter from the vicinity of the Niti Pass. Stoliczka considered it very remarkable that "*Ammonites Aon*" occurring in Niti had not been found in Spiti.

Meanwhile considerable progress had been made in the knowledge of the geology of the Alps. D. Stur stated concerning the set of fossils collected in Lombardy by A. Escher v. d. Linth and preserved in the Museum at Zurich, that the Cephalopoda of Dont, Cenceníghe and Val Inferna, hitherto attributed to the Buntsandstein[3] by Fr. von Hauer, occur in black limestone with fossils of the Muschelkalk, and consequently were to be regarded as Cephalopoda of the Alpine Muschelkalk.[4] As a result of this suggestion Fr. von Hauer recently undertook an investigation[5] of the Cephalopoda of the lower trias and distinguished, besides the lower Cephalopoda horizon, another Cephalopod fauna of the Alpine Muschelkalk. Simultaneously with Fr. von Hauer, E. Beyrich[6] also occupied himself with the Cephalopod fauna of the Alpine Muschelkalk, of which he had received a number of very beautiful specimens from Reutte through the labours of Mr. Kutschker.

In these works both Fr. v. Hauer and Beyrich seized the opportunity of giving their views upon the Cephalopoda of the Himálayan trias, upon which Oppel also had published a memoir.[7] Both pointed out the close relationship of the Indian forms to those of the species of the Alpine Muschelkalk, which was also recognised by Oppel. Beyrich specially affirmed with great confidence that the Cephalopoda known up to the present time from the Himálayan trias, provided that they all came from the same beds, represented a fauna of the Muschelkalk and not of the Keuper.

From this time the Cephalopod-bearing triassic limestone of the Himálaya was regarded as Muschelkalk, and there was a danger of the existence of a later Cephalopod fauna within the Himálayan region being doubted. It was left to the present energetic Director of the Geological Survey of India, Mr. C. L. Griesbach,[8] to prove by careful contour surveys that there are, in the trias of the Himálaya, several sharply circumscribed Cephalopod horizons, not only above, but also below the Muschelkalk. The fossils collected in these researches and sent to Vienna, to be worked up, indicated the existence of upper triassic localities, very rich in Cephalopoda, which were sufficient to encourage the undertaking of the above-mentioned Himálayan expedition.

---

[1] Calcutta, 1865.

[2] Geological Sections across the Himálaya Mountains. Mem. Geol. Survey, India, Vol. V, Part I.

[3] Palæont. Notizen. Sitzungsber. d. kais. Akad. d. Wiss. Mathem.-naturw., Cl. XXIV. Bd. 1857, p. 145.

[4] Jahrb. d. geol. Reichsanst., 1865, Verh. pp. 158, 245.

[5] Die Cephalopoden der unteren Trias der Alpen. Sitzungsber. d. kais. Akad. d. Wiss. Mathem.-naturw. Cl. LII. Bd. 1865, 7 December.

[6] Abhandl. d. Königl. Akad. d. Wiss. Berlin, 1866, pp. 105-179.

[7] Uber ostindische Fossilreste. Palæontol. Mittheil. Bd. I., pp. 267-302 (1863-65).

[8] Records Geol. Survey of India, Vol. XIII, Part 2, p. 94. Memoirs Geol. Survey of India, Vol. XXIII, Geology of the Central Himaláyas.

The following may be regarded as probably upper triassic forms, which together with Muschelkalk species, were described by Salter and Stoliczka :—

1. *Trachyceras*, sp. (Group of *Trach. duplica*) = *Ammonites Aon*, Salter, Palæont. of Niti, pl. VII, fig. 6.
2. *Arpadites Stracheyi* = *Ammonites Floridus, juv.*, Salter, l. c. pl. VIII, fig. 3.
3. *Hungarites nitiensis*, the keeled shells distinguished by Salter as young forms of *Amm. Floridus*, l. c. fig. 1, a-e of pl. VIII.
4. *Griesbachites Medleyanus*, Stol.
5. *Cladiscites indicus*, Mojs. (= *Amm. Gaytani*, Stol.)
6. *Isculites Hauerianus*, Stol.
7. *Lobites Oldhamianus*, Stol.[1]

Of these forms, those coming from the Niti Pass may occur in the crinoidal limestone with *Trachyceras tibeticum*, but the others in the so-called Daonella beds. From the character of the rock this may be tolerably certain for Nos. 4 and 5, but there is still a possibility that Nos. 6 and 7 were collected in the Anisic limestone,[2] but Dr. Diener, as also myself, think it more probable now that they occur in the Carnic beds (either in the crinoidal limestone with *Trachyceras tibeticum*, or in the so-called "Daonella beds").

I have spoken of the few cephalopod remains, collected by Griesbach from the upper triassic beds, in the above-cited preliminary communications. Griesbach remarked then in a letter[3] directed to me that the limestone of Kalapani with Tropites, formerly termed by him "Lias," occurs in a mountain region tectonically extremely disturbed, in which probably the conditions of the deposits were not correctly understood. The palæontological determinations alone were, therefore regarded as adequate. Unfortunately the expedition of 1892 did not succeed in finding in the sections examined these Tropites limestones, which are thus only known in Griesbach's first locality, near Kalapani, so that, for the present, we are still confined to the palæontological results with regard to this important and interesting horizon.

Besides the meagre older material of Strachey, Stoliczka and Griesbach, the following descriptions of species are based upon the rich material gathered by the expedition of the year 1892. Five faunally characteristic horizons are to be distinguished which will be spoken of more in detail in the last chapter.

Moreover, two ammonites, not occurring in the Himálaya, are included in the present work. These are a *Didymites* from Baluchistan[4] and a *Stenarcestes* from New Caledonia.

---

[1] The species mentioned under Nos. 4-7 were indicated by me in the "Vorläufigen Bemerkungen" (Sitzungsber 1892) as already pointing to Upper triassic deposits.

[2] For this reason Nos. 6 and 7 were also included in Diener's "Monograph of the Muschelkalk" (Palæontologia Indica, Ser. XV., Himálayan Fossils, Vol. II, Part 2, pp. 39, 82.)

[3] Anzeiger d. Kais. Akad. d. Wiss. Mathem.-naturw., cl. 1892, p. 174.

[4] The author has described this form as coming from Afghanistan ; this is a mistake. It was found in a loose block about 7 miles south of Hindubagh in Baluchistan.—*C. L. G.*

AMMONEA TRACHYOSTRACA.

A. TROPITOIDEA.[1]

a. *HALORITIDÆ.*

I HALORITES, E. v. Mojs. Cf. E. v. Mojsisovics, Die Cephalopoden der Hallstätter Kalke, Bd. II. p. 11.

The species of *Halorites* from the trias of the Himálaya belong, without exception, to the group of *Halorites acatenati.* The tuberculation which, transitory and very slightly indicated, was observed in a few Hallstatt species from the group of Acatenati, could not be observed in any of the Indian species of *Halorites* examined.

The Indian species, which in the adults are distinguished by a widely expanding last whorl and a rounded periphery, are connected through these features, in the first place with *Halorites suavis* and *Halorites mitis* from the Hallstatt limestones.

In the greater number of European species the periphery of the peristome is rectangular, the rounded periphery of the peristome is found only in the two above-named species, which, on account of their relationship to the Indian *Halorites* might be regarded as Indian types among the European *Halorites.* The rounded periphery of the peristome occurs further in the genus *Jovites,* which, owing to its widely expanding last whorl, possesses a great morphological similarity to the Indian species of *Halorites,* and is distinguished from these chiefly by the fact that the sutures are in a lower stage of development. The Indian species of *Halorites* have sutures which completely agree with those of the European species of *Halorites* and show like these three large principal saddles, whilst only two large principal saddles and a slighter indentation of all the sutural elements are to be observed in the genus *Jovites.* As *Jovites* is also the geologically older type, the suggestion might be made as to whether *Jovites* might not be considered as the ancestor of *Halorites.* It appears to me however more probable, considering that *Jovites,* to judge by its expanded body-chamber, has already entered upon a senile stage, that there exists between *Halorites* and *Jovites* a mere collateral relationship, and that both types might be traced back to a common primitive stock, which is as yet still unknown.

The sutures of our Indian *Halorites* show especially the greatest resemblance to those of the European *Acatenati.* Very remarkable is the feature, repeatedly observed, in the Indian specimens, that the last septa, which immediately precede the body-chamber, appear to be very much reduced in height, as well as in other features; thus the lobes have become short, the saddles truncated, so that the suture-line, which at one time showed Haug's euryphyll type, has now entered the stage of the stenophyll type. *Halorites semiplicatus,* appearing isolated in the Hallstatt limestone, has a suture-line showing great similarity to the degenerate suture-line of the Indian species of *Halorites*, and it is moreover to be observed that the lobes of *Halorites semiplicatus*, as they are seen in the last septum, immediately behind the body-chamber, are probably likewise degenerate. Also the suture-line of *Halorites superbus*, reproduced[1] by Haug, is perhaps already shortened by degeneration, and cannot be regarded as the type of the suture-line of *Halorites*.

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[1] In order to attain a conformity with the divisions of the Scythian, Jurassic and Cretaceous Ammonites I find myself obliged to give a higher rank to my groups, by raising families into groups and sub-families into families.

In my opinion too great a significance must not be attached to the deep indentations of the sutures of *Halorites*, and I cannot agree with Haug in considering this feature, together with the tuberculations of the catenate *Halorites* important enough to raise *Halorites* to the rank of the type of a special family—Haloritidæ—and to place it in his division of monacanthic (lanceolate) Glyphioceratidæ, whilst *Jovites* and the rest of my Haloritidæ, together with the Tropitidæ, are regarded as belonging to the family Tropitidæ, and placed in the division of the triænedic Glyphioceratidæ.[2] I look upon the deep indentations of the sutures of *Halorites* as a gradual and singular deviation from the type of the sutures of the Tropitidæ found in the dolichophyll stage. A slight sharpening of the points of the lateral lobes and of the external (siphonal) lobe is sufficient to produce the deep indentations of the *Halorites* lobes. As *Halorites* belongs to the youngest members of the Tropitidæ, I can only see in the greatly indented and well-differentiated lobes of this genus the highest degree of development which the lobes of the Tropitidæ have reached. Also in the family of the Ceratitidæ highly developed sutures sometimes show a similarly striking length of the points of the lobes. I specially refer to the lobes of *Trachyceras Aonoides* (Ceph. d. Hallst. K. II. Band, Taf. CXCI., Fig. 2). Also in a few species of the genus *Distichites*, provided with highly developed dolichophyll lobes, there occurs in the lateral lobes a stronger indentation of the point of the middle lobe. But of how little use the feature referred to is for classificatory purposes is best shown by the circumstance that even some typical forms of the group *Halorites catenati*, as for example, *Halorites catenatus* and *Halorites Alexandri*[3], possess bifid-divided lateral lobes, as in many species of *Sagenites*.

Furthermore, tuberculation of *Halorites* is also not in favour of a complete isolation of *Halorites*, as it is only confined to the group of *Catenati*, and can in this only be considered as a transitory stage, which disappears again in advanced age.

Finally, if Haug intends to trace back his family Haloritidæ to the carboniferous genus *Pericyclus*, while *Jovites* and *Juvavites* with the remaining Tropitidæ are regarded as descendants of *Gastrioceras*, only a few would be of his opinion, as the near relationship of *Halorites*, *Jovites* and *Juvavites* would be recognised by most palæontologists who, without prejudice in favour of certain theories, are engaged in a more minute investigation of these genera.

[1] Bull. de la Soc. Geol. de France, 1894, p. 398.

[2] The name Glyphioceratidæ is a synonym for my name *Trachyostraca*, which has the priority.

[3] Compare the figures of them. Ceph. d. Hallst. Kalke. Bd. II Taf. LXXIV, Figs. 1, 2

To come back to the sutures: it seems to me that their classificatory significance, which I have never denied, is considerably overrated by some of the more recent authors. How uncertain a guide the sutures are in the systematic division of the Ammonites, and how much scope they offer to the arbitrary judgment and the personal ideas of authors, is shown by the recent attempts at a classification of the triassic Ammonites by Haug and von Zittel, both of whom attach a systematic value almost exclusively to the sutures, and nevertheless, come to conclusions in which they differ considerably from each other. I do not intend entering upon a detailed criticism, but will only mention that the classification made by von Zittel[1] which, with complete disregard to the length of the body-chamber, makes use exclusively of the development-stage of the sutures as a criterion, relies upon simple horizontal sections through different stages of development, by which genetically diverging types are put together into families, and genetically connected types are distributed in other families. Hyatt's classification of the Goniatites, which I have mentioned in the foot-note, p. 1, of the second volume of the Hallstatt Cephalopoda, is based on similar conjectures. A certain originality cannot be denied to Haug's attempt at classification. Haug tries, namely, with reference to the *Leiostraca*, as well as the *Trachyostraca*, to form a conception as to their relationship from the primitive form of the sutural extremities, according as they may be one-pointed (monacanthic), two-pointed (dicranidic,) three-pointed (triænidic), or ceratitic (prionidic), and distinguishes in each of the two large chief divisions groups based only on the character of the sutural extremities. The consistent carrying out of this scheme, however, would lead in practice to very unnatural dismemberment on the one hand, and to fusion on the other, not to mention the fact that two such forms of suture are not really found united in the same individual. I can also see in these forms of suture only stages of development which follow one another in the different groups at different times, or also run partly for a time side by side.

All our attempts at classification have still too much the stamp of artificial construction and personal conception. I do not see any reason in this circumstance to give up such attempts, but I wish to emphasize again the fact that we are still very far from a natural grouping. The source of the principal mistake, which is so often repeated, lies in putting stress upon a single feature, which through an arbitrary conception, is regarded as the most important one, although experience has often taught that the same features may not seldom be found repeated in different groups, either at the same time, or at different times. It must not therefore be overlooked that the separation of branches and twigs of one and the same stem, which in their totality form a natural family, can be differentiated more or less in their more important features. Some branches may be kept back in their development, and retain their old features, while other branches, closely related genetically, acquire new features, through which they appear to us as more highly developed forms. To the source of mistakes which arise from this unequal development of closely related types may be added the numerous errors which spring from the equal development in different groups.

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[1] Grundzüge der Palæontologie.

Of the different features which have to be considered in the classification of the Ammonites—the character of the sutures and their position relative to each other, the length of the body-chamber, the shape of the peristome, the sculpture, the epidermis—none by itself can be a safe guide in judging of the conditions of relationship of the various genera, although each feature may be of importance for the single genus. The determination of the genetic connection is the only guide to rely upon, and in this we have only succeeded in a very imperfect manner up to the present time, on account of the incompleteness, still very considerable, of the existing palæontological material. The knowledge of the great and important group of Ceratitoidea is in this respect the farthest advanced. We can trace it nearly in an unbroken succession from the Scythian series to the Rhætic stage. But even in this group of Ammonites there is still some room for further elucidation.

Where the genealogical tree of a family cannot be built up by direct observation, it will be useful to weigh all or several of the above-mentioned features one against the other carefully for the approximate judgment of the conditions of relationship and for putting the material together into groups and families. The sutures, which, within so large a series of related forms as are contained within the *Leiostraca* and *Trachyostraca*, show no remarkable deviations, are of importance for this grouping. Of the three modes of development of the sutures, the phylloid, the leptophyll and the dolichophyll, the first two are confined to the *Leiostraca*,[1] while the dolichophyll mode of development is characteristic of the *Trachyostraca*. The stages of development, which may be observed within these modes (*viz.*, lanceolate, monophyll, dimeroid in the phylloid sense of the term ; lanceolate, ceratitic, brachyphyll, leptophyll in the leptophyll plan of variation ; clydonitic, ceratitic, brachyphyll, dolichophyll in the dolichophyll mode of development) may occur in the same groups or families beside one another, as it is not necessary that the single diverging branches should develop in the same manner. There is the danger in the permian and triassic Ammonites, which are in the process of change from the goniatitic to the ammonitic stage, of attributing to such stages of development of the sutures a high degree of systematic significance not due to them, and I cannot help again pointing out this source of error. The conditions of relationship can generally only be ascertained by means of the morphological characters, the length of the body-chamber and the conditions of the sutures, but where it is possible, also by observing the ontogenetic stages. It is then shown, in many cases, that the shape and sculpture of the shells stand in a certain relation, not yet explained, to the arrangement of the sutures. I mention with reference to this, first the so-called Arietid forms,[1]—to which are also to be added the *Margarites, Distichites, Styrites* and *Tropiceltites*. It may further be pointed out that the occurrence of secondary lobes and saddles is always connected with a flat, disc-shaped, high-mouthed form of the shell. As the embryonic whorls of the Ammonoidea are always spherical and low-mouthed, it is to be supposed in this case that the addition of the secondary lobes and saddles, inserted from the external part, is caused only by the extremely quick growth of the height of the whorl. Even in the group of the *Trachyostraca* the division of the external saddle is occasionally shown in the quick increase of the height of the whorl, which reminds us of the secondary lobes and saddles of the *Leiostraca* (*Thetidites, Hauerites, Cyrtopleurites*). Analogous cases could also be proved in jurassic Ammonites. These divisions of the external saddle are especially remarkable in the cretaceous genera *Sphenodiscus* and *Engonoceras*.

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[1] The phylloid and leptophyll modes of development are, in many cases, not so sharply divided as might be supposed by observing the typical forms of both modes. Not only may both be united in the same individual, as in *Pinacoceras*, where the secondary and the auxiliary saddles are of dimeroid form, and the principal saddles of leptophyll form, but the sutures of leptophyll mode of development not rarely show an inclination to dimeroid division of the saddles, as, for instance, many *Gymnites* and *Ptychites*.

The length of the body-chamber is also in a certain way related to the shape of the shell. High-mouthed shells generally possess a shorter body-chamber than shells with a low mouth. Young individuals have likewise a shorter body-chamber than adult specimens of mature age. Slight differences in the length of the body-chamber are also known within a single genus. I should like, therefore, to point out that too great an importance must not be attached to this feature, and that every little variation must not be made use of to establish a new genus. I would also oppose the other extreme which denies any systematic significance to the length of the body-chamber.

In my opinion the proper course is the middle one between these two extremes, and the length of the body-chamber carefully used is a very valuable classificatory feature.

While the sutures and the length of the body-chamber are of importance for the determination of more distant relationships, the conditions of sculpture play, with the constant help of the ontogenetic method, an important part in the establishment of the degrees of nearer relationships.

The difficulties of natural grouping are very great, as it is not a question of grouping according to superficial similarities, but of finding the natural affinities (genealogical trees) which can, of course, only be monophyletic. As the single genera must be monophyletic, the same claim must also be made for the grouping of genera into families and sub-orders. The natural family can only be considered to be monophyletic, and genera, whose nearer relationship and common origin appear to be excluded from one and the same type, must therefore not be united into one family.

1. HALORITES PROCYON, E. v. Mojs., Pl. I, Figs. 1—4 ; Pl. II, Figs. 1-2; Pl. III, Figs. 1-2.

This type is subject to many variations in size, form and suture-line. The outlines of the shell offer the most striking variations, so that a *varietas recta* and a *varietas obliqua* are to be distinguished. Within these two chief varieties there are still further distinctions to be observed in the dimensions of the full-grown adult individuals.

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[1] Cf. M. Neumayr, Zur Kenntniss der Fauna des untersten Lias. Abhandl. d. Geol. Reichsanst VII, Bd. 5, Heft, p. 45.

The *Varietas recta* is represented by Fig. 4, Pl. I, Fig. II, Pl. II, and Figs. 1·2, Pl. III, while the *Varietas obliqua* is shown in Figs. 1—3 on Pl. 1, and Fig. 1 on Pl. II.

In the *Varietas obliqua* the inner (chambered) whorls, as also the outer, modified whorl (body-chamber) of mature individuals are distinguished by a distinctly oblique-elliptical contour, which is produced by the retardation of the growth in height, occurring periodically at intervals of half a whorl.

The inner whorls cover one another almost entirely. They are wider than high (Fig. 1, on Pl. III, Fig. 3, on Pl. I.). The sides and the external part are inflated and not marked off from each other.

In the *Varietas obliqua* the external part appears to be less inflated in the region of the depression, as if it had been slightly compressed. The shell sinks down with a rounded umbilical margin into the very narrow umbilicus.

The strongly developed sculpture consists of wide, flatly rounded ribs, which are separated from one another only by narrow intercostal grooves and which continue without interruption over the sides and the external part in a tolerably straight radiating manner. Bifurcations of the ribs are to be observed at different heights. A primary division often occurs near the umbilical margin, and these primary, divided ribs, as also those chief ribs which do not undergo a bifurcation in the umbilical region, are often bifurcated on the sides for the second time, or for the first time. Some ribs, however, run across the sides without bifurcation, whereby tripartite bundles of ribs, instead of the more frequent quadripartite, arise. Further bifurcations appear then occasionally on the external edge, without having a corresponding bifurcation on the opposite half of the shell. The internal cast figured in Fig. 3, Pl. I, of *Var. obliqua* is distinguished by the constant appearance of such bifurcations of the ribs on the external part. There is, however, no correspondence of the ribs in this specimen, for even the chief ribs do not agree in their mode of division on both halves of the shell.

In the *Varietas recta* also the constant appearance of the bifurcation of the ribs on the external part was observed in one specimen—on the chambered part of the shell as well as at the beginning of the body-chamber.

Some specimens show in the last half whorl preceding the body-chamber, and also at the beginning of the body-chamber, in the middle of the external part, an indistinct, broad, longitudinal swelling, which does not however produce an interruption, but only an indistinctness of the transverse sculpture of the external part. But this median longitudinal line does not always keep exactly to the centre of the external part; for it shows, especially at the beginning of the last whorl, a slight inclination towards the left half of the shell.

The thickness of the ribs is subject to some variation; it appears to be generally the rule that those specimens which only reach their individual maturity after having attained considerable dimensions have coarser ribs than those which attain the stage of maturity when their dimensions are less. In the latter the ribs are less numerous and finer.

The last whorl or body-chamber of adults always takes a shape different from that of the inner whorls. A change of sculpture is always connected with these changes in the shape of the shell. As to the shape, a narrowing and a gradual individualisation of the external part takes place at the beginning of the last whorl, with which at the same time an accelerated increase of height begins in the *Var. recta*, while in the *Var. obliqua* there is a considerable reduction in the height of the first half of the last whorl; which increases again at the end of the first half of the whorl, but then more rapidly. It is in consequence of these features that *Var. obliqua* also shows on the side opposite the mouth a very strong inflation, which is distinguished from the inflation lying in the same position one whorl back by the strong narrowing of the external part. In the anterior half of the last whorl in the two varieties there is again a gradual widening and inflation of the external side, which appears to be in some individuals slightly flattened, in others slightly inflated, in the portion next to the region of the greatest compression.

The external part is thus always widely inflated near the mouth. The margin of the mouth itself is only partly preserved in the example of *Var. recta* given in Fig. 4, of Pl. 1. It bends, as it seems, along the whole circumference of that part of the tube lying external to the egression. There is a short convex lobe projecting anteriorly on the external side.

The umbilicus of the last whorl of the body-chamber is closed with a callus in the specimens having the shell preserved; in casts, on the other hand (as is the case with all the figured specimens showing the umbilical region), it is open. The egression of the whorl, which is much less expanded when the shell is preserved than in the casts, occurs in the anterior half of the last whorl. The reason for this lies in the fact that a wide shell-band, running along the margin of the egression, is superposed directly upon the shell of the preceding whorl. The margin of the egression can therefore begin on the cast only outside this (then-broken-off) band.

The sculpture of the last whorl of the body-chamber shows a tendency to become flattened and gradually obsolete on the umbilical side and, on the other hand, gradually to thicken and form knobs on the external edge. On the posterior half of the last whorl the ribs begin to be more widely separated from one another, to flatten and to bend more or less in such a way that the concavity formed by the ribs, which now advance strongly towards the external part, seems to open towards the anterior end of the shell. In this region there are not seldom, with respect to the casts of the inner whorls, deviations in relation to the divisions of the ribs. Gradually the ribs become fainter on the sides of the shell, whilst they thicken towards the external edge. In the region of the greatest compression of the last whorl, at the mid-length of the body-chamber, there appear, simultaneously with the weakening of the sculpture of the sides, distinct marginal knobs, which in the anterior half of the last whorl again become somewhat fainter and approach nearer to one another. In this region there are often strong lines of growth on the shell at the external part. The knobs mostly disappear again immediately behind the margin of the aperture.

The length of the body-chamber comprises a complete whorl. The large specimen figured on Pl. II, fig. 2, shows some faint longitudinal lines on the sides of the cast of the body-chamber. Whether these lines have originated through injuries during the lifetime of the animal, as we assumed to be the case in some European species of *Halorites*, must be left undecided.

The normal-line was also observed on the cast of the body-chamber in the vicinity of the aperture.

The size of full-grown individuals is subject to some variation. The largest individual before me is a specimen belonging to *Var. recta* (Pl. II, fig. 2). The smallest, referred to the same variety, reaches a diameter of 56 mm.

Sutures.—The not inconsiderable individual variations which are shown in our illustrations of the sutures might lead to the supposition that there were here several species which could not be distinguished. Although we do not wish to exclude this probability we are inclined, nevertheless, to the opinion that we have only to deal with one species which is somewhat variable in the sutures. But above all, attention must be drawn to the feature, frequently observed in the Tibetan species of *Halorites*, *viz.*, that the later suture-lines of full-grown individuals become more and more simplified as they approach the last of them. The last septum, which then, as a rule, is only separated from the preceding septum by a very slight space, is distinguished by the short form of the saddles and the much less numerous and coarser denticulations of the lobes and saddles. Such a greatly simplified suture-line is represented by Fig. 1d on Pl. I, whilst the suture line, Fig. 3c, of the same plate, provided with high, slender saddles, and graceful indentations, is taken from an internal cast. The suture-line, Fig. 4c of Pl. I, is the fourth counted from the last on the left half of the shell. It already approaches the simplified form of the last suture-line, which resembles very much the last represented in Fig. 1 d, but shows proportionally broader and lower saddles.

The dolichophyll-shaped suture-line generally bears completely the character and habit of the Juvavian species of *Halorites* of the European Mediterranean Province.

The deep external lobe is divided into two narrow, deep and one-pointed halves, by a high, laterally slightly serrated median projection of nearly rectangular outline. The points of the lobes either converge somewhat towards the median projection, or are parallel to it.

The two lateral lobes are, like the halves of the external lobe, one-pointed, and the first of them reaches beyond the depth of the external lobe. It is, therefore, the deepest of all the lobes. With the exception of about the last four suture-lines, immediately preceding the modified body-chamber, which, as mentioned above, always becomes shorter and more stumpy, the lateral lobes are distinguished by their narrow and deep points. Corresponding with these three principal lobes are three strongly developed, slender, dolichophyll, serrated saddles, of which the external one reaches the greatest height.

In sharp contrast to the principal lobes and saddles, the auxiliary lobes and saddles are only very poorly developed and may all be regarded, as in the large European species of *Halorites*, as a wide umbilical suture, bent upwards towards the umbilicus and divided into several small serrations (saddles). There may be from five to six of such serrations up to the umbilical suture.

Dimensions.—

	Internal cast.	*Adult form of Var. obliqua.*
Diameter	56 mm.	85 mm.
Height of the last whorl	27 „	28 „
Thickness „ „ „	39 „	40 „
Width of umbilicus	2 „	13[1] „

Locality and Geological position.—Juvavian stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 35.

2. Halorites sapphonis, E. v. Mojs., Pl. IV, Figs. 1-4.

The establishment and limitation of this species offers also in the present form, on account of its great individual variability, not inconsiderable difficulties, though they are fewer than in *Halorites procyon.*

The variations chiefly comprise the dimensions of mature individuals, and the conditions of the ornamentation as well as of the sutures.

The casts of the inner whorls, which are thicker than they are high and very narrowly umbilicated, possess a greatly developed ornamentation extending over the sides and the external part. This ornamentation differs from that of *Halorites procyon* in the bending of the ribs on the sides and in the constant appearance of bifurcations of the ribs on the external part of the shell.

As to the bending of the ribs on the sides, they form a concavity directed forwards, as may be seen on the cast figured on Pl. IV, Fig. 2. Bifurcations of the ribs occur on the sides at different heights, but mostly on the lower half, beside the umbilical margin. A two- to four-fold bifurcation of the ribs takes place on the margin of the external part, so that here occur bundles of narrow fine ribs instead of the broad ribs on the sides.

The external part is crossed in a straight line by the foremost bifurcated rib, whilst the second and third, following in similar bundles, have a convexity directed backwards. There is no exact correspondence between the bifurcated ribs on both sides of the shell. Some bifurcated ribs join with the more anteriorly or posteriorly lying principal rib; others again break as intercalated ribs on the opposite side, without being joined to a principal rib. The position at or before which the bifurcation of the ribs on the external part occurs, is distinguished in a number of specimens by a more or less distinct knotty swelling (Figs. 3, 4, Pl. IV). In some specimens there occur also occasionally close-set, fine, transverse ribs, which do not bifurcate on the external part nor show any knotty marginal swellings.

The last whorl of the body-chamber of adult individuals changes its shape in a similar manner to that in *Halorites procyon*, but the increase in height and the narrowing following from this on the external part are not so marked as in that species.

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[1] Egression of umbilicus.

The callus closing the umbilicus is followed by the curved line of the mouth-margin, which expands farther on casts than on specimens having the shell, for reasons explained in the description of *Halorites procyon.*

The sculpture of the last whorl of the body-chamber of adult individuals generally shows a tendency to thicken into marginal knobs on the external part, whilst the sculpture on the sides becomes weaker and almost entirely disappears on the anterior half of the surface in the region of the umbilicus.

The occurrence of irregular undulations of the ribs on the sides of the shell on the posterior part of the body-chamber whorl is very characteristic of *Halorites sapphonis.* The knot-like undulations are produced by the interference of normal transverse ribs, here very wide apart; these have faintly-indicated striated ribs (only visible in well-preserved specimens in an oblique light) running obliquely from the umbilicus across the sides, anteriorly towards the external part. Through the crossing of those two systems of ribbing there arises a kind of reticulation on the sides, which reminds us somewhat of the crossing of forward and backward running curves, met with in the beaded ornamentation of the European species of the catenate *Halorites*, but which is essentially differentiated therefrom by the direction of the cross ribs, which produces the reticulation.

In some specimens there arises on the second half of the penultimate whorl or only on the last whorl of the body-chamber, in the middle of the external part, a strong keel-like ridge (Fig. 4b. Pl. IV), accompanied by distinct longitudinal lines. This does not actually cause an interruption but only a slight weakening of the transverse sculpture passing over the external part. This ridge disappears again in the region of the marginal knobs. The latter, mostly well-developed, begin to appear, some of them earlier, some later, but in any case before the strongest compression and narrowing of the external part and reach almost to the mouth-margin, gradually getting wider apart and finally disappearing altogether.

In some specimens there is a flattening of the external part united with a weakening of the ribs thereon in the region of the marginal knobs; but in other individuals the external part remains slightly inflated. Specimens having the shell preserved show on the peripheral area between the marginal knobs well-developed lines of growth running in a straight direction.

The dimensions of the shell in mature individuals vary within the same limits as in *Halorites procyon.* The largest full grown form which is before me is represented in Fig. 1, on Pl. IV; the smallest mature form, preserved with the entire modified body-chamber whorl, attains a diameter of about 47 mm.

Sutures.—The presence of the feature already mentioned in connection with *Halorites procyon* may here also be established, *viz.*, that the last suture-lines of the adult individuals undergo a considerable reduction in the height of the saddles and their lateral branches, which are thus much more simple than the septa about a fourth of a whorl farther back. The isolated suture-line, Fig. 2c, of Pl. IV, is taken from the posterior half of the last whorl of the cast (Fig. 2a, 2b). The saddles are here much more slender and the lateral branches finer than in the last suture-lines immediately preceding the body-chamber. The last suture-line bordering the body-chamber in the specimen figured on Pl. IV, Fig. 4, is represented in Fig. 4c. In comparison with the suture-line, Fig. 2c, taken at about the same height of the whorl, the lobes appear shallower, the saddles considerably lower, and less finely formed.

The details of the suture-line agree in their fundamental features with those of the sutures of *Halorites procyon.* The three strongly developed principal saddles of which the external one reaches the greatest height are followed by an umbilical suture, which is divided into several (4-5) small auxiliary saddles, and bent upwards towards the umbilicus. The position of the sutures is normal.

Dimensions of an adult specimen.—

Diameter	75	mm.
Height of the last whorl	28	„
Thickness „ „ „	36	„
Width of aperture of umbilicus	14·5	„

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 17.

3. Halorites Charaxi, E. v. Mojs., Pl. III, Fig. 4.

Though at the first glance this form seems to possess a great similarity to *Halorites Alcaci*, a more minute examination shows that it is not allied to this species but rather to *Halorites procyon.*

It is especially the ornamentation of the inner casts, recognisable at the beginning of the body-chamber whorl, as well as the course of its ribbing, agreeing with *Halorites procyon*—in contrast to the irregular undulations of the ribs in *Halorites Alcaci*—which allows us to distinguish *Halorites Charaxi* without difficulty from *Halorites Alcaci.*

The inner whorls appear to possess approximately equal height and width. The sculpture consists of numerous flattened ribs, separated by very narrow intercostal furrows. The conditions of the bifurcation of these ribs seem to agree with those of *Halorites procyon.*

The body-chamber whorl, modifying its shape, is very considerably compressed in the middle third of its course, so that the sides become quite flat, whilst the external part is greatly narrowed and pointed.

After the commencement of the umbilical opening, which runs in the form of an arch and comprises about half of the last whorl—whether this is preceded by a callus closing the umbilicus could not be ascertained—the compression of the whorl reaches its culminating point, while towards the mouth there occur again a widening of the external part and a slight inflation of the sides which always lose in height in consequence of the umbilical opening. On a cast this opening seems to be considerably wider than in specimens having the shell preserved, on account of the well known circumstance that the shell is superposed closely upon that of the preceding whorl.

With regard to the modifications in the sculpture of the body-chamber whorl, the ribs become at the beginning of the latter broader and flatter, and the intercostal furrows considerably wider. On the external edge there appears gradually a knot-like thickening of the ribs which are but faintly indicated on the external part. The number of the marginal knobs is greater than in any other species known, which is attributable to the fact that there is in the region of the marginal knobs only a slight widening of the ribs, which increase in thickness in the marginal region and become knob-like. In the last half of the last whorl there occurs first on the sides but later also in the marginal region a complete obliteration of the sculpture.

Sutures.—Only the last three suture-lines are visible which are very near one another and evidently already greatly reduced in height. They appear to agree in general with the sutures of *Halorites procyon.*

Dimensions of an adult specimen.—

Diameter	62	mm.
Height of the last whorl	21·5	„
Thickness	20	„
Width of the umbilical opening (on the cast) about	18	„

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 1.

4.—Halorites phaonis, E. v. Mojs., Pl. III, Fig. 5; Pl. V, fig. 1.

I regard the form with the edge of the aperture preserved figured on **Pl. V**, as the type of the present species, which is closely related to *Halorites procyon.*

Halorites phaonis is distinguished from *Halorites procyon* chiefly by its much more slender and more compressed form and by the closer and finer ribbing of the inner whorls.

The bifurcation of the ribs, as well as the variations of the sculpture occurring on the body-chamber whorl, agree with the same features as are met with in *Halorites procyon.* The external part remains inflated in the region of the marginal knobs. The sculpture crossing over the narrow external part shows broad ribs whose convexity is directed posteriorly; these ribs are greatly weakened in the median region. On the anterior part of the body-chamber whorl indications of the marginal knobs remain visible, it is true, up to the region of the apertural margin, but there occurs also in this species a considerable weakening of the sculpture, which coincides with the increase of the inflation of the external part and of its widening.

The edge of the mouth is bent up in a trumpet-like manner on the cast.

The umbilical opening comprising about half the last whorl is, to all appearance, preceded by a callus closing the umbilical depression.

The incomplete specimen, figured on Pl. III, Fig. 5, is distinguished from the typical form by more finely ribbed inner whorls, by the appearance of spiral lines on the compressed part of the body-chamber whorl and the deviations of the widely separated fold-like ribs caused by these lines. The external part of this specimen is somewhat more flattened in the region of the marginal knobs on the last whorl. The ribbing is almost entirely obliterated by a median smooth band.

Sutures.—In the last suture-lines preceding the body-chamber there occurs a simplification similar to that which occurs in *Halorites procyon*. The suture-line given on Pl. III is the penultimate one, whilst the fifth from the last is represented on Pl. V.

With reference to the details of the suture-lines there is no essential difference to be observed in comparison with the species occurring in the same horizon, unless it be that the number of the serrations in the little saddles forming the umbilical suture is somewhat less.

Dimensions of an adult specimen.—

Diameter	75	mm.
Height of the last whorl	26	„
Thickness	30	„
Width of the umbilical opening	13	„

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 2.

5. HALORITES ALCACI, E. v. Mojs., Pl. III, Fig. 3.

This species is to be regarded as a form closely related to *Halorites sapphonis*, both by the nature of the sculpture of the casts of the inner whorls and the irregular bending of the fold-like ribs at the beginning of the last whorl.

The cast of the inner chambers is somewhat more compressed, but nevertheless thicker than high. The flattened, fold-like ribs are much more numerous and narrower than in the species with which this is compared; they seldom have bifurcations near the umbilicus but more frequently on the sides and on the external part (cf. Fig. 3c), and on the latter in such a manner that the bifurcated rib either closes again on the other half of the shell or runs on bifurcated. In the latter case, therefore, one rib of one half of the shell corresponds with two ribs of the opposite half. The ribs run nearly straight on the sides, or with manifold bifurcations more strongly bent outwardly, so that a concavity arises which opens anteriorly.

The body-chamber whorl of adult forms is distinguished by a very distinct, widely expanding, arch-shaped opening appearing after the callus which closes the umbilical depression, as well as by the great number of closely set marginal knobs. On the posterior part of the last whorl, where the compression has already begun, the widely separated ribs are to be seen; they are irregularly branched and provided with faint knotty swellings similar to those of *Halorites sapphonis*, but without any cross ribbing being perceptible.

Towards the margin of the aperture which sends forth a projecting external lobe the external part is widened and inflated, the marginal knobs disappearing entirely.

On the median line of the external part one observes two fine longitudinal grooves on the cast of the body-chamber whorl; these enclose a median thread-like band (Fig. 3b). On the anterior part of the last whorl this band, corresponding to the so-called normal line, disappears.

Sutures.—Not known.

Dimensions.—

Diameter	52 mm.
Height of the last whorl	17 „
Thickness „ „ „ „	23 „
Width of the umbilical opening	12·5 „

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 1.

2. JOVITES, E. v. Mojs., cf. Cephalopoden der Hallstätter Kalke, Bd. II, p. 13.

1. JOVITES, n. f. ex aff. J. bosnensis, Pl. IX., Figs. 4, 5.

The two figured fragments belong to mature specimens whose body-chamber whorl not only shows the very distinct umbilical opening, but also parts of the whorl in the vicinity of the mouth-margin.

The two fragments differ from one another with reference to the cross section of the anterior part of the last whorl, as well as with reference to the height of this anterior part, but I am of opinion that these differences are only individual and perhaps caused by the somewhat different dimensions.

The general form, the sculpture on the casts of the inner whorls and the umbilical opening of the body-chamber whorl agree essentially with *Jovites bosnensis* (E. v. Mojsisovics, Cephalopoden der Hallstätter Kalke, II. Bd, p. 52, Taf. LXXXIII, Figs. 2-3, Taf. CXCVI, Fig. 6), and only the sculpture of the body-chamber on the umbilical margin proves that we have to deal here with a species different from *Jovites bosnensis.* Whilst, namely, in *Jovites bosnensis,* as well as in *Jovites dacus,* the sculpture changes into broad, flat, undivided folds on the umbilical margin of the body-chamber whorl, the character of the ribs and their bifurcations remain in the present species the same as they were in the earlier parts of the shell. Another feature which distinguishes the present species from *Jovites bosnensis* is the persistence of the faint keel-like projection in the middle of the external part extending to the end of the last whorl.

Sutures.—Not known in detail. The suture-line, simplified by weathering, shows the remarkable contrast between the two principal saddles and the auxiliary saddles, so greatly reduced in height, a contrast characteristic of *Jovites.*

Dimensions.—

Diameter	70 mm.
Height of the last whorl	25 „
Thickness	34 „
Width of the umbilicus	20 „

Locality and Geological Position.—In the red Limestone with crinoids of Kiogarh Range, south of Sangcha Talla. Number of specimens examined, 4. Also some specimens from the Tropites-Limestone of Kalapani appear to belong to the present species.

2. JOVITES cf. dacus, E. v. Mojs., cf. *Jovites dacus*, E. v. Mojs., Cephalopoden der Hallstätter Kalke, Bd. II, p. 49, Taf. LXXXIV, Figs. 1—8.

An internal cast, elongated and distorted, from the Tropites-Limestone of Kalapani lies before me, which in shape and sculpture agrees well with the casts figured on the above-cited Plate, as Fig. 6. But as neither body-chamber nor sutures are known it must remain undecided whether there exists a specific agreement with *Jovites dacus*, or whether we have here only a very closely related representative species.

3. JOVITES, ind. ex aff. J. daci.

A partly silicified internal cast of 44 mm. in diameter agrees in outer form with the internal casts of *Jovites dacus*, but is distinguished from these by the somewhat coarser sculpture and also by the more complicated sutures.

The sculpture, which has the same direction as in *Jovites dacus*, consists of much broader, flat, fold-like, transverse ribs, which seem to be somewhat interrupted on the external part by the median keel-like projection, in which the horny well-preserved siphuncle lies. Such an interruption does not take place in *Jovites dacus* but also here perhaps the somewhat defective preservation may have caused the appearance of one.

The suture line shows, especially on the pretty well recognisable external saddle, a considerably richer dolichophyll branching, which reminds us of the degree and manner of bifurcation of the more highly developed typical species of the genus *Halorites*. We may refer for comparison to the sutures of *Halorites Alexandri* of the middle Juvavian beds of Europe (Cephalopoden der Hallstätter Kalke, II Bd., Taf. LXXIV, Fig. 2c).

The present species, like *Jovites dacus*, possesses only one lateral lobe, for the projection of the preceding whorl coincides with the first lateral saddle.

Locality and Geological Position.—From layer No. 2 of the Daonella beds of Rimkin Paiar. Number of specimens examined, 1.

3. PARAJUVAVITES, E. v. Mojs.

This group of forms, rather rich in species, agree in sculpture with the European species of *Juvavites* of the group of *Interrupti*, and are distinguished from *Juvavites*, in which genus a narrowing of the umbilicus occurs in the mature stage, by the opening of the umbilicus, which begins on the last whorl before the aperture. *Parajuvavites* takes a kind of morphologically intermediate position between

Halorites and *Juvavites* on account of this feature; but it must be here specially emphasized that a genetic link can in no way be formed by it between the genera just mentioned.

Parajuvavites stands very near to the genus *Halorites* through its sutures, especially through the development of three principal saddles, which are mostly followed by only slightly developed auxiliary saddles and are as disconnected as those of *Halorites*. The less markedly dolichophyll bifurcation might partly at least be accounted for by the smaller dimensions of the specimens used in the investigation. The lobes are throughout one-pointed, as in *Halorites*, but it is seldom that the middle point reaches the same depth as in the latter genus. But there is also a great similarity with the lobes of the typical species of *Juvavites*. As a distinction it can only be mentioned that in *Juvavites* whenever auxiliary saddles appear they are better developed and proportioned.

Parajuvavites may be established as one of the most characteristic genera of the lower Juvavian sedimentary rocks of the Indian trias Province and occurs as well in the horizon below the Halorites-Limestone as in the Halorites-Limestone itself.

Of all the forms which are known in Europe the isolated lower Juvavian *Jovites mercedis* (Cephd. d. Hallst. Kalke, II. Bd., p. 55, Taf. LXXXV, Figs. 1-5) shows the greatest similarity with *Parajuvavites*, without being related to any of the Indian species. Supposing this species belonged to *Parajuvavites*, it would indicate a group of ***Continui*** with an uninterrupted transverse sculpture on the external part, while the Indian species would form a group of ***Interrupti***. After separating *P. mercedis* from the genus *Jovites*, the latter, which possesses two large saddles in the typical representatives—in contrast to the three large saddles of *Halorites* and *Parajuvavites*—seems to be much better defined as a genus.

1. PARAJUVAVITES BLANFORDI, E. v. Mojs., Pl. V, Fig. 2; Pl. VIII, Figs. 6, 7.

This species is represented by two varieties. The one, which is characterised by its obliquely elliptical outline, may be distinguished as *Var. obliqua*. It is given in Fig. 2 on Plate V. The second variety—*Var. recta*—has the normal form. It is shown in Figs. 6 and 7 on Plate VIII.

The inner whorls, almost overlapping one another, and being very narrowly umbilicated, are considerably thicker than they are high and provided with a broadly inflated external part. In *Var. obliqua* there are at distances of half a whorl apart inflations caused by a greater increase of height and between which there are regions in which the whorl is reduced in height.

Full-grown individuals possess a widening body-chamber whorl on which the sides become considerably flattened; this is connected with gradual compression. While on the inner whorls, corresponding with their considerable thickness, there is a rather high umbilical wall, there is an extremely low one on the widening whorl with flattened sides. There is again a slight inflation towards the aperture and a widening of the external part. There is only a portion on each side of the mouth-margin preserved in the form, Fig. 6 on Pl. VIII. The invagination of the margin is distinctly seen. The small specimen figured (Fig. 7, Pl. VIII) is by no means, as one might suppose, only an internal cast. It possesses, on the contrary, as it seems, the whole of the last whorl, the body-chamber and may therefore, as it agrees otherwise completely with the internal casts of *Parajuvavites Blanfordi*, be regarded as a specimen with body-chamber which is not yet full-grown and therefore not yet provided with a widening body-chamber whorl.

The sculpture consists of strong ribs, separated by broad intercostal furrows and bifurcated beyond the middle of the sides of the shell. These ribs, tending as they do to go in an almost straight direction, do not altogether do so but somewhat incline towards the anterior part, running from the umbilicus across the sides to the external part, where they undergo an interruption in the middle region made by a smooth band. Three-fold bifurcations of the ribs occur isolated also on the inner whorls, and the place where they bifurcate lies somewhat lower on the body-chamber of mature individuals.

The specimen of *Var. recta* shown in Fig. 6 on Pl. VIII. is remarkable on account of the occurrence of a fine longitudinal line visible at the beginning of the last whorl, which is similar to the normal lines on the cast of the external part. The form (Fig. 2, Pl. V) attributed to *Var. obliqua* shows knob-like swellings at the extremities of the marginal ribs in the narrowed region of the body-chamber whorl. This feature reminds us of the marginal knobs of *Halorites*. The above-mentioned specimen is further distinguished from the other forms before me of both varieties by the fact that the ribs on the body-chamber whorl are wider apart from one another.

The length of the body-chamber comprises more than a whole volution.

Sutures.—In a similar manner to the Indian species of *Halorites* it is also here shown that in mature individuals the suture-lines seem to be very close together and the height of the saddles compared with the preceding suture-lines seems to be shortened. This feature can be distinctly traced in the figured cast (Fig. 2, Pl. V) on the external saddles, as the penultimate whorl is freed through the breaking off of part of the last whorl.

The dolichophyll suture-line is distinguished by the rapid decrease in the height of saddles in the direction from the external saddle to the auxiliary ones. The steep inclination of the external saddle seems to be remarkable compared with the deep external lobe, which is divided by a high median projection. The second lateral saddle is directed on the inner side towards the umbilicus, badly individualised and only indistinctly separated from the two or three following small auxiliary saddles.

Dimensions of an adult specimen.—

	Var. recta cast.
Diameter	69 mm.
Height of the last whorl	28 „
Thickness	29 „
Width of the umbilical opening	10 „

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 4.

2. Parajuvavites Laukanus, E. v. Mojs., Pl. V, Fig. 3.

The globose figured shell is an adult individual with the apertural margin preserved.

At the beginning of the last whorl the sides and external part are much inflated. Later there occurs a narrowing of the external part, together with a flattening of the sides, followed towards the end of the last whorl by a depression, which is connected again with the somewhat increasing inflation of the sides as well as with a broadening of the external part. The umbilical opening is not considerable though it comprises about half a volution.

The aperture of the mouth is contracted by the invagination of the margin of the shell.

The sculpture shows strong ribs bordered by deeply cut intercostal furrows, the ribs forming a slight concavity which opens anteriorly on the sides, and a slight convexity towards the anterior on the external part. In the median line of the external part the ribs are partially interrupted on the body-chamber cast by a smooth band, whilst at the beginning of the last whorl the shell does not show such an interruption, but the ribs are continuous on the external part. The above-mentioned band on the external part is bordered on both sides by a thread-like line—the normal line.

With reference to the divisions of the ribs on the sides the simple forked division at half the height of the sides is the rule. Owing to the circumstance that two neighbouring chief ribs occasionally unite in the vicinity of the umbilicus there arise four-fold divided bundles of ribs. Three-fold divided bundles are seldom observed.

Sutures.—Not known.

Dimensions.—

Diameter	50 mm.
Height of the last whorl	27 ,,
Thickness	30 ,,
Width of the umbilical opening	6 ,,

Locality and Geological Position.—Juvavian Stage; found in débris near Lauka, *e.g.*, probably in the Halorites-Limestone. Number of specimens examined, 1.

3. Parajuvavites Sternbergi, E. v. Mojs., Pl. V, Fig. 4.

The figured specimen which may stand as the type of the species, possesses an obliquely elliptical outline, which is caused by the depressions at the beginning of the last whorl and at the beginning of the anterior half of it. But we can recognise no specific character in this feature, judging by the experience gained in the case of

Halorites procyon and of *Parajuvavites Blanfordi*. We are therefore inclined to assign two fragments to *Parajuvavites Sternbergi*, as they agree in shape and sculpture with the type species, from which however they are distinguished by their normal form.

The narrowly umbilicated shell consists of widely embracing whorls, which are also higher than broad where they are still chambered. On the anterior half of the body-chamber whorl there is a distinct compression, connected with a corresponding narrowing of the external part. Extremely insignificant and scarcely noticeable is the opening egression of umbilicus. On the other hand the figured specimen, which is the only one well preserved, shows a distinct inflexion, or it may be described as a very sharp bend on the external side, near the aperture. It has almost the appearance as if here an individual, or perhaps a pathological abnormality existed, for on this apparently compressed part irregularly running lines of growth are observable on the cast. The margin of the aperture itself is not preserved.

The sculpture at the beginning of the last whorl is rather crowded. The numerous, distinctly formed transverse ribs are separated from one another by intercostal furrows which are as broad as the ribs. On the body-chamber whorl the ribs, as well as the intercostal furrows, increase very rapidly in width, so that a considerable contrast in the strength of the ribbing is shown on the last whorl.

The divisions of the ribs occur at varying heights on the sides, sometimes in the vicinity of the umbilicus, sometimes in the middle of the sides and sometimes beyond it. The bundles of ribs arising out of these divisions are mostly four-fold. More rarely the ribs are only singly divided; in these the bifurcation always takes place only beyond the middle of the sides. The ribs run nearly straight and only show a slight bend whose concavity is directed anteriorly. The transverse sculpture is slightly interrupted in the middle line of the external part. The two halves of the shell do not exactly correspond in their sculpture, the ribs occurring alternately in the middle line. At the beginning of the last whorl, on the external part, the cast shows to the left of the median smooth band a continuous longitudinal line, and to the right knob-like swellings of the ribs which evidently correspond with the longitudinal line on the other side. Also on the margin of the external part here flattened knob-like swellings of the ribs are noticeable.

On the anterior part of the last whorl the smooth area of the external part widens and occupies the whole width of the greatly narrowed external part, immediately behind the contracted part of the shell near the aperture.

Sutures.—Similar to those of the other species of *Parajuvavites.*

Dimensions.—

	In the line of contraction.
Diameter	54 mm.
Height of the last whorl	28 „
Thickness	16 „
Width of the umbilicus	3·8 „

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 3.

4. PARAJUVAVITES FEISTMANTELI, GRIESBACH, Pl. VII, Figs. 1—3.

1880. *Tropites Ehrlichi*, var. *Feistmanteli*, Griesb., Palæontological Notes on the Lower Trias of the Himálayas. Records, Geol. Surv. of India, Vol. XIII., Pt. 2, p. 98.

1891. *Tropites Ehrlichi*, var. *Feistmanteli*, Griesb., Geology of the Central Himálayas. Mem. Geol. Survey of India, Vol. XXIII, p. 142.

1892. *Halorites*, ind., E. v. Mojs., Vorläufige Bemerkungen über die Cephalopoden-Faunen der Himalaya Trias. Sitzungsber. kais. Akad. d. Wiss., Bd. CI., p. 3.

The originals of Griesbach's species are two somewhat weathered, loose, internal casts from Rimkin Paiar[1] which very probably belong to the same species as the specimens lying before me from Bambanag, but this is by no means beyond doubt. It might in fact be a question whether the species distinguished here as *Parajuvavites Jacquini* is not identical with Griesbach's originals. As a correct decision as to the close relationship of the two forms is impossible, I will, in order to retain the name of Griesbach's species, make use of it for the present one. The somewhat more slender shape and the finer ribbing of Griesbach's casts, in comparison with those of *Parajuvavites Jacquini*, induce me specially to do this.

The inner casts only possess a narrow umbilicus in consequence of the deep embracing of the whorls. The external part is inflated and connected by a swelling with the sides which ascend towards the umbilical margin.[2] The whorls are somewhat higher than broad. The transverse sculpture upon the middle of the external part is, in consequence of the incomplete correspondence of the two halves of the shell, interrupted by a band-like area. It consists of fold-like rounded ribs, separated by narrow intercostal furrows, which in their course across the whorl turn from the umbilicus only a little towards the anterior. Divisions of the ribs occur on the sides at half of their height or beyond, and bundles of ribs arranged in a three-fold manner are prevalent. Some of the chief ribs running from the umbilicus are distinguished by greater strength, especially on the lower half of the sides.

The body-chamber whorl of full grown specimens is distinguished by a rather considerable compression of the whorl occurring before the commencement of the widening of the umbilicus. This compression reaches the end of the posterior half of the whorl. Coinciding with the umbilical opening, which extends over half of the last whorl, there again occurs a slight depression of the whorl which reaches its culminating point with the slight inflexion of the external part appearing at the aperture. The height of the umbilical wall decreases slightly as the umbilicus widens.

With reference to the sculpture of the body-chamber whorl: two-fold ribs as well as three-fold ones are seen on the posterior half of it, whilst almost exclusively two-fold ribs occur on the anterior half.

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[1] I had placed these casts in the above-cited communication in *Halorites* without having any knowledge of the last whorl.

[2] In the front view, Fig. 2b., the umbilical margin has been wrongly represented as turned upwards. The cause of this erroneous representation arose from the circumstance that on the anterior broken edge part of the area of the sides was broken off, whereby the umbilical margin appeared to jut out.

Near the aperture the ribs unite over the external part. Here they are also narrower and stand closer together.

Parajuvavites Feistmanteli is, as above mentioned, very closely related to *Parajuvavites Jacquini.* As distinguishing features, besides the dimensions, there may be mentioned the flatter shape of *Parajuvavites Feistmanteli*, the not inconsiderable compression of the last whorl and the appearance of three-fold ribs on its posterior half.

Sutures.—The indistinctly dolichophyll suture-line reaches its greatest depth in the first lateral lobe, which, like the two halves of the external lobe and the other lobes is one-pointed. The greatest height is reached by the slender external saddle, which is followed by the other saddles, decreasing rapidly in height. Of auxiliary lobes there are three to four beyond the umbilical margin. The first of them has the least depth, whilst those following towards the umbilicus increase in depth. The slight depth of the group of auxiliary lobes is remarkable when compared with the lateral lobes.

Dimensions.—

Diameter	72 mm.
Height of the last whorl	30 "
Thickness	27 "
Width of the umbilicus	11 "

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 6; and in the same horizon near Rimkin Paiar, 2.

5. Parajuvavites Jacquini, E. v. Mojs., Pl. VI, Figs. 4—7; Pl. VII, Figs. 1-2.

The individual variations to which this species in respect to its size as well as its ribbing is subject are not unimportant. There are, however, transitional forms between the extreme individuals which are figured here, so that there can be no doubt that they are specifically identical.

The species is closely related to *Parajuvavites Feistmanteli* and the internal casts of *Parajuvavites Jacquini* are only to be distinguished from the casts of *Parajuvavites Feistmanteli* by their somewhat coarser ribbing and their mostly somewhat thicker shape. Although the external part is as a rule rounded, it is in some specimens, as in the cast figured on Plate VII, somewhat flattened.

But a correct distinction between the two closely related species is only possible in specimens which are full grown and provided with a body-chamber whorl. While *Parajuvavites Feistmanteli* shows, in consequence of the considerable compression in the region of the aperture, an obliquely elliptic outline of the body-chamber whorl, the compression in *Parajuvavites Jacquini*, connected with no extraordinary increase of height, occurs somewhat later, almost coinciding with the umbilical opening, and the outline of the whole shell is not remarkably influenced by the compression which is principally confined to the narrowing of the external part. At the aperture there is an inflexion of the shell which is strongest on the external part and through which the lumen of the tube suffers no inconsiderable contraction (Fig. 4, Pl. VI).

While the inner whorls show no variations worth mentioning in the strength and proximity of the ribbing, very important individual deviations occur on the body-chamber whorl. In figure 4, Pl. VI, the form with the most close-set ribs is represented. At the beginning of the last whorl this specimen still shows three three-fold divided ribs—this three-fold division is the rule in the inner whorls—which are then followed by singly forked ribs. Towards the aperture the ribs are closer together and become finer and three-fold ribs occur here and there, but these always follow undivided single ribs.

The specimen, namely, Fig. 5 of the same plate, possesses broader ribs separated by wide intercostal furrows on the body-chamber whorl. These ribs are only at the beginning of the whorl twice trifurcate, but otherwise, with a single exception, only bifurcate. Towards the aperture the position of the bifurcation of the ribs is more and more outwards.

In specimen, *viz.*, Fig. 6 of the same plate, there are only forked ribs, separated by very wide intercostal furrows and therefore far apart from one another. Also in this specimen, distinguished by its small size, the position of the division of the ribs is more and more outwards towards the aperture.

In the similarly small specimen, Fig. 7 of the same plate, the ribs are on the greater part of the last whorl wide apart and separated from one another by broad intercostal furrows. Only towards the aperture, where the external part widens again, the ribs become more numerous and are thus necessarily closer together. There are no tripartite ribs in the whole circumference of the last whorl, but single undivided ribs are here and there to be observed. The predominant kind of rib-division is the bipartite one. The part near the umbilical opening seems smooth on the cast, so that the ribs only begin beyond this smooth area.

In Figure 1 of Plate VII a complete specimen is represented, which is equal in size to the last specimen spoken of (Fig. 7, Plate VI), but is distinguished from it by much more numerous and closer-set ribs. Tripartite ribs are found especially on the posterior part of the last whorl, but also here and there in the anterior regions. The bipartite rib is here also the predominant one. The area surrounding the umbilical opening is smooth on the cast. In the median region of the external part the sculpture is interrupted by a smooth area where the ribs die out. Only in the foremost part of the body-chamber whorl the sculpture covers the external part more or less completely.

Sutures.—With respect to the suture-line, the feature mentioned under several species of the closely related genus *Halorites*, *viz.*, the simplification of the last closely set suture-lines, must also here be stated to exist. Internal casts show more complicated sutures with high slender saddles and deep lobes, whilst the last sutures are distinguished by the widening and lowering of the saddles, associated with more simple indentations.

Contrasted with *Parajuvavites Feistmanteli* important differences in the course of the suture-line are scarcely to be established, except that the lateral lobes in *Parajuvavites Jacquini* appear nearly two-pointed and that beyond the umbilical margin there are in *Parajuvavites Feistmanteli* four, in *Parajuvavites Jacquini*, on the other hand, only two auxiliary lobes.

Dimensions.—

Diameter	60 mm.
Height of the last whorl	25 ,,
Thickness ,, ,, ,,	24 ,,
Width of the umbilicus	8 ,,

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 24.

6. PARAJUVAVITES TYNDALLI, E. v. Mojs., Pl. VII, Figs. 3, 4.

Like *Parajuvavites Feistmanteli* and *Parajuvavites buddhaicus* the present species is also distinguished by an obliquely elliptical outline of the body-chamber whorl. But while in the above-named two species the position of the strongest compression, respectively, of the expansion caused by it, is just half a whorl behind the aperture, a depression lies in *Parajuvavites Tyndalli* half a whorl behind the aperture and the strongest expansion is only a fourth of a whorl behind the aperture. *Parajuvavites Tyndalli* shares with *Parajuvavites buddhaicus* alternating regions of depression and compression, and both are distinguished by this feature, which appears on the second half of the penultimate whorl, from *Parajuvavites Feistmanteli*, in which only a single expansion occurs on the last whorl.

In the last expansion connected with a very considerable compression the previously widely arched external part narrows in *Parajuvavites Tyndalli* into an obtuse narrow arch and increases in width again towards the depressed aperture. This strong pointing of the external part is not visible in our front view, Fig. 3b, for the reason that it only occurs in the anterior half of the last whorl. The present species also has the same circumference at the umbilical opening as *Parajuvavites buddhaicus.*

With reference to the character of the sculpture there exists a greater similarity however, to *Parajuvavites Feistmanteli.* The rather strong ribs are on the inner whorls mostly tripartite, but on the body-chamber whorl partly bipartite, partly tripartite and here and there even also quadripartite. In two forms to which the figured one belongs, the ribs are compressed together fold-like; in two other specimens, on the other hand, they are smaller and raised. On the external part the sculpture is interrupted by a smooth band.

Sutures.—The sutures shown in the illustration form the penultimate of the strongly interlocking last suture-lines, probably considerably reduced in height. To all appearance the suture-lines lying farther back might have much slenderer higher saddles and agree with the sutures of related species in essential points. Beyond the umbilical margin there are three small auxiliary lobes. The first lateral lobe ends in a deep point. Its double point is an error of the draughtsman, who drew the point at the side of the external saddle down to the middle of the lobe.

Dimensions.—

Diameter	60	mm.
Height of the last whorl about	26	„
Thickness of the last whorl	20	„
Width of the umbilicus about	7	„

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 4.

7. Parajuvavites Renardi, E. v. Mojs., Pl. VII, Fig. 5.

This slender form seems to be most closely related to *Parajuvavites buddhaicus* from which, apart from its much smaller size, it is specially distinguished by its regular outline and by the fact that the external part is never pointed.

At the beginning of the last whorl the small shell possesses a narrow, slightly flattened external part and flat slightly inflated sides, which after the commencement of the umbilical opening become still flatter, increasing at the same time in height. The external part widens again towards the aperture without becoming flatter. Though the umbilical opening does not expand widely, it comprises however more than half of the last whorl.

The sculpture consists at the beginning of the last whorl of closely-set fine ribs which fork at various heights and are strong and rounded at their upper end. These ribs are mostly arranged in bundles of four or five. Ribs which are only once forked are rare. The sculpture is interrupted on the external part and shows a thread-like longitudinal line at the beginning of the last whorl which soon disappears again and which does not exactly keep to the middle of the external part but inclines somewhat towards the left.

With the beginning of the umbilical opening, especially on the sides, the ribs become broader and more fold-like, the intercostal furrows increase in breadth and the forked ribs are not distinctly joined to the strong chief ribs but run into the broad intercostal furrows of the chief ribs, without any strongly marked boundary. On the anterior part of the last whorl, where the external part widens again, the ribs, which have been interrupted up to this on the external part, close completely, forming a short arched external lobe in such a manner that the ribs which have again become much stronger and very distinctly marked on the sides reach their greatest strength in the middle of the external part. This therefore evidently shows a tendency of the ribs to close together and to become stronger at the termination of the body-chamber whorl. At the aperture the shell bends slightly over towards the lumen of the tube.

Sutures.—Not known.

Dimensions.—

Diameter	43	mm.
Height of the last whorl	19	„
Thickness „ „ „	13	„
Width of the umbilicus	5	„

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 1.

8. Parajuvavites Ludolfi, E. v. Mojs., Pl. VII, Figs. 7-9.

That these specimens belong to a species which is distinguished by an extraordinarily small umbilical opening and are not to be regarded as incomplete examples of a form with a wider umbilical opening, is especially proved by the form, Fig. 8, which is provided with a contracted aperture. But that also the two other specimens, in which, it is true, the aperture is wanting, are almost completely full grown individuals, is seen in the closing together of the ribs in the sculpture of the external part, which in *Parajuvavites* begins as a rule, only in the last part of the last whorl in mature individuals. The two specimens, namely, Figs. 7 and 8, represent a somewhat smaller flatter variety, with flatter external part, whilst the form, Fig. 9, belongs to a larger, thicker variety whose external part is more rounded.

The beginning of the opening, which comprises the anterior half of the last whorl, but is only associated with a comparatively slight widening of the umbilicus, is remarkable on the sides for its compression and on the external part for its narrowing. As a rule there is a widening towards the aperture again of the external part caused by the depression which exists there.

With reference to the sculpture, which consists of strong broad ribs with wide intercostal furrows, the form represented in Fig. 7 is distinguished by the strong bending of the ribs on the sides. The bipartite rib is the predominant one. Through the joining of the stems of two neighbouring forked ribs there arise bundles of quadripartite ribs. Tripartite ribs are seldom observed. The large specimen, Fig. 9, shows more faintly developed and more fold-like ribs in the compressed region of the sides.

On the external part of the inner whorls and on the greater part of the body-chamber whorl the sculpture is interrupted, a condition which is connected with the alternate appearance of the ribs coming from both sides. Only in the last fourth of the last whorl the above-mentioned closing of the ribs takes place, which is at the same time associated with their strengthening.

Sutures.—The simple form of the sutures, which keep the middle course between brachyphyll and dolichophyll development, might be traced to the fact that the sutures, represented in Fig. 7, are the last which immediately precede the body-chamber. The type of suture is the same as in the other species of *Parajuvavites.* There are two small auxiliary lobes outside the umbilical margin. The two halves of the external lobe, as well as the lateral auxiliary lobes, are one-pointed.[1]

Dimensions.—

Diameter	43	mm.
Height of the last whorl	20	,,
Thickness ,, ,, ,,	14	,,
Width of the umbilicus	4	,,

[1] That the lateral lobe has two points in our illustration is due to an error on the part of the draughtsman.

Locality and Geological Position.—Juvavian Stage; of Halorites-Limestone of the Bambanag Section. Number of specimens examined, 4.

9. PARAJUVAVITES MINOR, E. v. Mojs., Pl. VII, Fig. 6.

This form is closely allied to *Parajuvavites Ludolfi*, and is perhaps only a variety of that species. But as no transitional forms are known, and not only its smaller size but also the finer and much more closely set sculpture may be taken as distinguishing features, it seems to me advisable to regard *Parajuvavites minor* as an independent form.

The slightly compressed shell, provided with a rounded, not very wide external part, possesses an umbilicus which is proportionally wide and only has a very small umbilical opening on the anterior part of the body-chamber whorl. The stronger compression of the whorl which occurs in other species is here scarcely indicated by reason of the small umbilical opening. Towards the aperture, however, there is a slight depression of the whorl especially noticeable on the flattened portion of the external part. The margin of the aperture is not preserved; but from some fragmentary remains it is to be seen that the tube has also in the present species undergone a narrowing through the inflexion of the aperture.

The bundles of ribs arising through their division comprise furcations 2 to 5 in number. In the bundles, which are more than tripartite, the first furcation occurs in the vicinity of the umbilical margin. The other furcations are beyond the middle of the sides. On the inflected part of the aperture the ribs are distinguished by greater fineness and a more crowded condition. On the external part the sculpture with alternating ribs coming from both halves of the shell is slightly interrupted in the median line, and the tendency of the ribs to continuously cross the external part is only exhibited in the region of the aperture. Interrupted ribs are also here predominant, associated with uninterrupted ones which irregularly alternate with the former.

Sutures.—Not known in detail.

Dimensions.—

Diameter	34 mm.
Height of the last whorl	17 „
Breadth „ „ „	12 „
Width of the umbilicus	4 „

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 1.

10. PARAJUVAVITES BRINTONI, E. v. Mojs., Pl. X, Fig. 8.

By its dimensions and the strength of its sculpture this species shows the greatest resemblance to *Parajuvavites minor*, from which it is, however, distinguished by the greater expansion of the umbilical opening and the greater width of the umbilicus caused by this, as well as by the alternating appearance of strongly developed principal ribs.

The small shell possesses slightly flattened sides and a flattened external part, separated from the sides by rounded margins. The umbilicus is already proportionally wide before the beginning of the umbilical opening which comprises more than the anterior half of the body-chamber whorl.

The sculpture shows striæ-like folds, which, however, vary somewhat through the occurrence of isolated, strongly swollen ribs. These stronger chief ribs are specially shown in the posterior half of the last whorl, but also here and there on the extreme anterior part of this whorl. The paired division of the ribs is also in this form the predominant one but tripartite ribs also occur. Two neighbouring stem ribs sometimes unite on the lower half of the sides, whereby bundles of four to five divisions arise.

The intercostal furrows increase in width towards the aperture, so that the ribs are now wide apart from one another. Lines of growth running parallel with the ribs occur also in this region.

On the external part the sculpture on the posterior part of the last whorl is slightly interrupted by the alternation of the ribs; but on the anterior half of the last whorl the ribs run in undiminished strength and uninterruptedly across the external part.

Sutures.—Not known.

Dimensions.—

Diameter	32	mm.
Height of the last whorl	15	„
Thickness „ „ „	11	„
Width of the umbilicus	6	„

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 1.

11. PARAJUVAVITES BUDDHAICUS, E. v. Mojs., Pl. VIII., Figs. 1—5.

The inner whorls, excluding the penultimate, show normal outlines caused by their regular growth. Where the shell-diameter is 10 mm. they are already higher than they are wide and possess a well-inflated external part which gradually passes over into the sides which ascend towards the umbilical margin. The whorls are almost completely embracing, so that only a very narrow umbilicus remains open.

The body-chamber whorl takes an obliquely elliptical form in contrast to the inner whorls and shows in its anterior half a considerable widening of the umbilicus caused by its divergence towards the aperture. Taken as a whole the body-chamber whorl, looked at from the side, appears egg-shaped, whereby the aperture of the shell coincides with the longitudinal axis of the egg. The greatest compression, which is connected with a very considerable narrowing of the external part, lies thus opposite the mouth, half a whorl backwards. This compression, as may be seen especially on the incomplete example of the body-chamber in Fig. 3, is preceded by an inflected portion, in which the breadth of the external part visibly diminishes.

In the anterior half of the body-chamber whorl a depression again occurs, following which the breadth of the external part gradually increases again towards the aperture. At the mouth itself a slight lateral and external inflexion of the shell towards the lumen of the tube takes place.

The sculpture consists of very numerous, fine, transverse ribs which on the inner whorls in the middle line of the external part seem only to be very slightly weakened, so that they almost continuously cross the external part. The bundles which arise from the manner in which the ribs are forked are tripartite to quadripartite. The stronger stem-ribs of the simple bundles, however, close together in the region of the umbilicus with their neighbouring ribs, whereby pairs of bundles arise composed of two simple bundles of ribs.

On the body-chamber whorl there is as a rule on the external part a more or less pronounced interruption of the sculpture. In some forms, as, for instance, in that represented in Fig. 1, there arises on the strongly pointed external part a keel-like, smooth band by which the transverse sculpture coming alternately from both halves of the shell is interrupted. On the right side this band, confined to the posterior third of the body-chamber whorl, is bordered by a fine incised line. The ribs close together again on the external part, towards the aperture. The lateral sculpture is likewise subject to some variations on the body-chamber whorl. In the typical specimen, Fig. 1, coinciding with the commencement of the narrowing of the external part the stem-ribs are conspicuous. They are wide apart from one another, increase in breadth and are swollen, knob-like, at less than half the height of the sides. The considerably widening intercostal furrows, however, remain smooth, without showing separated secondary ribs. Only towards the outer margin the inserted secondary ribs appear then again, but disconnectedly, without being visibly joined to the stem-ribs. From their short course and their position these secondary ribs remind us of the marginal knobs of *Halorites.* Towards the aperture the connection between the primary and the secondary ribs is again noticeable, but the primary ribs are closer together and appear therefore more numerous. Specimens with remnants of the shell preserved (Fig. 3a) show distinct lines of growth on the broad stem ribs of the compressed portion. In other specimens as, for instance, in the variety represented in Fig. 2, the connection between the primary and secondary ribs is, it is true, not broken as in the typical forms, but the secondary ribs appear flattened and indistinct as compared with the primary ribs. The bundles are mostly quadripartite.

Sutures.—The suture-line shown in Fig. 3b is taken from the septum immediately preceding the body-chamber of a full-grown specimen. It is reduced in height compared with the sutures of the preceding chambers, so that the external saddle especially seems to be greatly widened at its base. The saddles are, on the whole, slender and the lobes wide. In the young the denticulation is very weak, so that one might almost speak of brachyphyll development (Fig. 5). The sutures take later the dolichophyll form.

The two halves of the external lobe, separated by a rectangular median projection, as well as the other lobes, are one-pointed. The external and the first lateral lobe reach about the same depth. Outside the umbilical suture are one to two auxiliary lobes. The external is the highest of all the saddles, but the height given to it in Fig. 3b seems to be somewhat exaggerated. Also the details of the highest point in the saddle are so far incorrectly represented as to show that no furcation into two branches of nearly the same height exists. The external saddle ends, moreover, as in the other species of *Parajuvavites*, with the principal stem, undivided at the top, whilst below the summit of the saddle, on the external part, a larger lateral branch frees itself, which in the drawing has been drawn too high.

The length of the body-chamber comprises an entire whorl.

Dimensions.—

Diameter	63 mm.
Height of the last whorl	28 „
Thickness „ „ „	18·5 „
Width of the umbilicus	6 „

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 32.

12. PARAJUVAVITES STOLICZKAI, E. v. Mojs., Pl. IX., Figs. 2, 3.

The species here described, which of all the forms known up to the present time seems to be the one most closely related to *Parajuvavites Blanfordi*, is distinguished from that species, as well as from all other species of the genus *Parajuvavites* by the proportionally widely opened umbilicus. In contrast to the narrowly-umbilicated chambered casts of other species, the umbilicus in *Parajuvavites Stoliczkai* is already pretty widely opened on the casts of the inner whorls. After the beginning of the umbilical opening, which is connected with a stronger compression of the sides, the width of the umbilicus increases in a greater degree on the anterior half of the mature body-chamber whorl. On account of the relative width of the umbilicus of the inner whorls the umbilical opening is not so striking in its appearance as in species with narrowly umbilicated inner whorls.

The two figured specimens somewhat differ from each other in the outer form as well as in the ornamentation, and are to be regarded as varieties of one species. The narrower form, Fig. 2, Pl. IX, possesses more numerous ribs and appears in consequence more closely ribbed than the other (broader) one, Fig. 3, which is provided with stronger ribs following one another at wider intervals. Slight differences between the two varieties also exist in reference to the mode of division of the ribs. The tripartite division of the ribs prevails over the bipartite in the more finely ribbed variety, whilst in the more coarsely ribbed variety the reverse of this takes place. The place of division in the latter, towards the end of the last whorl, is farther outwards, and not rarely the divisions assume the character of intercalations in both varieties.

The ribs coming alternately from both halves of the shell are interrupted on the external part by a smooth band, which in the coarsely ribbed variety increases in width on the anterior half of the last whorl. Whether the ribs close together on the external part near the aperture in this variety as is the case in the finely ribbed variety, Fig. 2, cannot be determined on account of the incomplete preservation of the specimen represented in Fig. 3.

It must be remarked, however, that after the beginning of the divergence of the umbilical margin towards the aperture the sides, in their lower half, lose the inflation which they had shown before and become quite flat.

Variations in size are also to be observed in *Parajuvavites Stoliczkai.* There is a nearly complete finely ribbed specimen, provided with a body-chamber whorl, 41 mm. in diameter, in which towards the anterior end of the last whorl the ribs on the external part close completely together.

Sutures.—Not known.

Dimensions.—

Diameter	78 mm.
Height of the last whorl	33 „
Thickness „ „ „	9 „
Width of the umbilicus	16 „

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 5.

13. PARAJUVAVITES, n. f. ind., Pl. IX., Fig. 1.

The last whorl of the specimen figured belongs for the greater part to the body-chamber, but as the anterior half of the body-chamber whorl is wanting it cannot be determined whether we have to deal with an incomplete full-grown, or with an incomplete young form. It appears, however, as if the umbilical opening would begin near the anterior broken margin, for the sides become here flatter and the curvature of the umbilical margin seems to change its course. In that case one would be dealing with an incompletely-preserved full-grown specimen which might be related to *Parajuvavites Jacquini.* At the beginning of the last whorl the thickness is still greater than the height, but at the end of it (where, as mentioned, probably the umbilical opening begins with the compression of the whorl) this condition has changed. The height has become somewhat greater than the thickness. The umbilicus is open and proportionally wide.

But the most striking feature consists in the conspicuous sigmoidal curvature of the ribs on the sides, which are narrowest near the umbilical margin and increase considerably in width towards the outer margin. The intercostal furrows are very wide, so that, as a rule, bifurcated ribs are not very numerous.

An interruption of the alternately-appearing ribs takes place on the truncated external part as far as the chambered part of the shell extends. On the body-chamber, on the other hand, the ribs close together in the middle of the external part in a pointed angle.

Sutures.—Saddles and lobes have a brachyphyll denticulation. There is an auxiliary lobe outside the umbilical margin.

Dimensions.—

Diameter	33 mm.
Height of the last whorl	17 „
Thickness „ „ „	14 „
Width of the umbilicus	4 „

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 1.

4. JUVAVITES, E.v.Mojs., Cf. Cephalopoden der Hallstätter Kalke, Bd. II, p. 74.

The genus *Juvavites* in the wider sense (or the "Juvavitinæ," as may probably be said when the knowledge of the group becomes more extended) is represented in the Indian trias by some indeterminable remnants of *Juvavites*, s. str., coming from the Daonella beds and the Hauerites beds, by some species of *Anatomites* and finally by a peculiar type allied to *Juvavites*, s. str., which will bear the designation *Griesbachites*. This new sub-genus is distinguished by marginal knobs, which already appear on the chambered whorls. In several species of *Juvavites* and *Anatomites* such marginal "ears" show themselves on the body-chambers of adult individuals; but in *Griesbachites* these marginal "ears," as above mentioned, are also present on the inner, chambered casts.

Griesbachites Medleyanus may be taken as the type of the genus. In the Mediterranean trias the genus is likewise known, but is very rare (G. *Kastneri*, Ceph. der Hallst. Kalke, II Bd., p. 95, Taf. CXCVI., Fig. 3).

Whilst the sutures show the closest relationship between *Griesbachites* and *Juvavites*, the presence of marginal knobs in the genus *Griesbachites* indicates a certain morphological agreement with knob-bearing forms of the group of *Sagenites reticulati*, from which, however, they are distinguished by the absence of longitudinal striæ.

a. ANATOMITES.

1. JUVAVITES (ANATOMITES) BAMBANAGENSIS, E. v. Mojs., Pl. XI., Fig. 1.

This species is allied to *Anatomites rotundus* (Ceph. der Hallst. Kalke, Bd. II, p. 98, Taf. LXI., Figs. 6, 7, 8, 9; Taf. LXXVI., Fig. 11; Taf. CXCVI., Fig. 11), from which it is distinguished especially by the disappearance of the paulostome ribs on the body-chamber. To this latter belongs about half of the anterior part of the last whorl, on the figured specimen, so that at least half a whorl is still wanting. Specimens with completely preserved body-chamber might therefore show no paulostome ribs at all on the last whorl by which they could foreshadow the appearance of a *Juvavites* from the group of *Interrupti.*

The present form agrees perfectly with *Anatomites rotundus* in its outer shape; but some deviations are shown in the sculpture of the chambered part of the shell. It is first to be remarked that in *Anatomites bambanagensis* the ribs are more numerous and much finer, whereby the intercostal furrows become narrower and flatter. The rib behind the paulostome furrow is more strongly inflated. On its posterior side two furcated ribs as a rule free themselves, so that it becomes tripartite. Owing to the fact that the forked rib preceding it joins it towards the umbilical margin a bundle of quinquepartite ribs may arise.

The number of the paulostome furrows occurring in the circumference of one whorl must have been considerably greater than in *Anatomites rotundus,* for in the posterior half of the last whorl in the specimen figured four paulostome furrows are still to be seen, whilst in *Anatomites rotundus* three to four paulostomes only occur in the circumference of a whole whorl.

The number of the ribs and the mode of their division vary in each area formed by the paulostome. The prevailing tendency is that the ribs which at first furcate outside the umbilical margin undergo yet another furcation farther outside, whereby bundles of tri- to quadri-partite ribs arise which likewise may fuse at their base on the umbilical margin. The paulostomes are divided by single ribs of normal strength. After the disappearance of the paulostomes the above-mentioned mode of division of the ribs becomes the prevailing one.

The transverse sculpture seems to be slightly interrupted on the middle line of the external part, though the ribs come from both sides correspondingly (not alternately). A slight weakening is also noticeable on the stronger ribs preceding the paulostomes.

Sutures.—Not known in detail. The degree of denticulation is about the same as in *Anatomites rotundus.*

Dimensions.—

Diameter	23 mm.
Height of the last whorl	12 „
Breadth „ „ „	18 „
Width of the umbilicus	2·5 „

Locality and Geological Position.—Carnic Stage; in the Daonella beds of the Bambanag Section. Number of specimens examined, 1.

2. JUVAVITES (ANATOMITES) EUGENII, E. v. Mojs., Pl. XI., Fig. 3.

The small chambered cast, with outlines similar to those of *Anatomites Caroli,* shows in the circumference of the last whorl only three paulostomes, which are however tolerably wide and divided by unforked middle ribs. The foremost of these paulostomes is only recognisable at its commencement on the anterior broken margin in the vicinity of the umbilicus. The number of the ribs occurring in the areas between the paulostomes is a very considerable one, as above 14 to 15 fine, sharp-edged, little ribs are present in the single bundles of ribs. It is further very noteworthy that behind the first paulostome in the posterior part of the last whorl the bundle of the ribs has a chain-like appearance, but in the next following anterior bundle this is not the case. Such chain-ribs have elsewhere been observed in the group of ***Anatomites intermittentes*** (cf. ***Anat. Frechi, Anat. Hyppoliti, Anat. dimidiatus, Anat. Beyrichi***, etc.)

With the exception of stronger paulostome ribs which close together on the external part, the ribs of the bundles occur alternately in the middle line of the external part. This interruption of the ribs runs like a smooth band through the whole length of the bundle to the paulostome ribs. The direction of the paulostome furrows is obliquely inclined towards the anterior.

Sutures.—Not known in detail.

Dimensions.—

Diameter	11·5 mm.
Height of the last whorl	5·5 ,,
Thickness ,, ,, ,,	6·5 ,,
Width of the umbilicus	1 ,,

Locality and Geological Position.—Carnic Stage; pyritised in the Daonella beds of Rimkin Paiar. Number of specimens examined, 1.

3. Juvavites (Anatomites) caroli, E. v. Mojs., Pl. XI., Fig. 2.

This species is comparable with ***Anatomites subrotundus and Anatomites Brochii*** from the Julian deposits of the Röthelstein, near Aussee.[1]

Anatomites subrotundus shows special resemblance to the species here described, agreeing with it also in the outline of the shell. But the number of the paulostomes as well as the number of the ribs occurring in the areas between the paulostomes differ and thus necessitate the form represented being made an independent species.

In the circumference of the last chambered whorl there are four paulostomes divided by unforked middle ribs. The division of the bundles of ribs between the paulostomes is eleven- to twelve-fold. The ribs appear to be very narrow and sharp-edged, and the intercostal furrows broad. The paulostome ribs as well as those ribs nearest to them curve over the external part with a convexity turned somewhat anteriorly.

Though both halves of the shell are formed symmetrically and the ribs correspond in direction, they have, on the external part in the middle line, a slight interruption which is likewise still faintly indicated in the paulostome ribs which are more strongly inflated on the external side.

The preceding whorl, seen in Fig. 2b, appears as in ***Anatomites rotundus*** (Ceph. d. Hallst. Kalke, II. Bd., Taf. 196, Fig. 11), excepting the distinctly developed paulostomes, to be smooth shelled, or provided only with faint indications of transversely running folds in the areas between the paulostomes.

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[1] Cephaloden der Hallstätter Kalke, Bd. II., pp. 103 and 104, Taf. XC., Figs. 5 and 10.

Sutures.—Not traceable in detail.

Dimensions.—

Diameter	21 mm.
Height of the last whorl	11·5 ,,
Thickness ,, ,, ,,	12 ,,
Width of the umbilicus	1·8 ,,

Locality and Geological Position.—Carnic Stage; silicified, in the Daonella beds S. E. of Rimkin Paiar. Number of specimens examined, 1.

b. GRIESBACHITES.

GRIESBACHITES MEDLEYANUS, STOLICZKA, Pl. X., Fig. 2.

1865. *Ammonites Medleyanus*, Stoliczka, Geological Sections across the Himálayan Mountains. Mem. Geol. Survey of India, Vol. V., p. 54, Pl. IV., Fig. 5.

1892. *Sagenites Medleyanus*, E. v. Mojs., Vorläufige Bemerkungen über die Cephalopoden-Faunen der Himalaya-Trias. Sitzungsber. kais. Akad. d. Wiss. Math.-naturw. Cl., Bd. Cl., Abth. I, p. 5.

1893. *Sagenites Medleyanus*, E. v. Mojs., Cephalopoden der Hallstäter Kalke, Bd. II., p. 157.

Stoliczka's original specimen, here figured anew, represents a chambered cast. The widely expanding shell only possesses a narrow umbilicus from which the overhanging inflated umbilical wall rises rather steeply to the rounded umbilical margin. The whorls are somewhat higher than wide, and are inflated moderately on the sides, but strongly so on the external part, with the greatest width near the umbilical margin.

The sculpture is only faintly indicated on the sides by very flat, scarcely perceptible folds, of whose possible mode of division nothing definite could be said. In contrast to this faint sculpture on the sides stands the tolerably strong and distinctly developed sculpture on the external part which begins in the spiral of the marginal tubercles distinguished by their remarkable size.

In the circumference of the last whorl there are fourteen marginal tubercles, while the number of the ribs on the external part seems to exceed fifty. The connection of the ribs with the marginal tubercles on the external part occurs only alternately, there being intervals of from two to three ribs without tubercles. This is shown in such a manner that one or two ribs run out from the marginal tubercles. The ribs on the external part run (forming a very slight anteriorly directed curvature) nearly continuously across the external part, in the middle line of which a slight weakening of the ribs becomes noticeable.

Sutures.—The existence of distinctly individualised auxiliary lobes, as well as the regular gradual decrease in size of each of the sutural elements in the direction of the umbilical suture from the external part are among the features which the present species has in common with other species of *Juvavites*, especially of the group of *Juvavites interrupti*, as, for instance, *Juvavites interruptus, Juvavites subinterruptus.*

The number of septa occurring in the last chambered whorl, where the shell has a diameter of 92 mm., amounts only to nine. As in spite of this the saddles of the posteriorly lying septa touch the lobes of the septa which immediately succeed them anteriorly, the lobes and saddles are very long and narrow.

The external lobe, which is somewhat shorter than the first lateral lobe, occupies, as is seen in the front view, Fig. 2b, a considerable breadth. It is divided into two points by a broad, tolerably high median projection which is depressed in the middle. The points incline towards the succeeding external saddles. Similar median projections are found pretty frequently in *Juvavites*, and have also been observed in the trachyostracan genera *Halorites*, *Sagenites*, *Tibetites* and *Hauerites*.

The lateral and auxiliary lobes end in one point, but the lateral lobes also possess shorter lateral points, which added to the deep middle point produce a three-fold division. The number of the auxiliary lobes external to the umbilical margin amounts to two. Internal to the umbilical margin a third auxiliary lobe succeeds and a fourth meets the umbilical suture.

The saddles are distinguished by a great number of lateral branches, which proceed from the long and slender stem. Above they end with three larger lappets.

Dimensions.—

Diameter	92 mm.
Height of the last whorl	51 „
Thickness „ „ „	44 „
Width of the umbilicus	8 „

Locality and Geological Position.—Horizon and Locality unknown, probably from the "Daonella beds" (dark limestone). Number of specimens examined, 1.

2. GRIESBACHITES HANNI, E. v. Mojs., Pl. X., Figs. 3-5.

Of this interesting form there are unfortunately only more or less fragmentary specimens before me, which are also partly distorted by pressure. To these belongs also the apparently still completely chambered specimen, Fig. 4, in which the umbilical margin is, on account of the compression it has undergone, more strongly marked than in the other fragments under consideration.

The shape of the shell seems in the more inflated variety, Fig. 3, to agree in general with the outline of *Griesbachites Medleyanus*, while the typical form, Figs. 4 and 5, possesses somewhat flatter sides and a distinct, subangular, umbilical margin. The thicker variety, as well as the type, is distinguished from *Griesbachites Medleyanus* besides by the considerably greater width of the umbilicus. But the nature of the ornamentation constitutes the most important distinction between *Griesbachites Hanni* and *G. Medleyanus*. The presence of a strong well-developed sculpture on the sides of the shell may in the first place be pointed out. A further striking feature of *Griesbachites Hanni* is to be found in the greater number of marginal tubercles.

The sculpture on the sides consists of strong, slightly sigmoidal ribs which increase below the middle of the sides by bifurcation or intercalation and which are mostly ornamented on the margin of the external part by more or less strong marginal tubercles. The increase of the ribs by division or intercalation is as a rule effected in such a way that the ribs are only bifurcated. But sometimes tripartite ribs represent one stem-rib running out from the umbilical margin.

In the fragment represented in Fig. 5, but only on the left half of the shell, a paulostome furrow was observed which caused certain deviations in the course, and in the division, of the succeeding ribs. The paulostome runs radially perfectly straight. The anterior paulostome rib joins the next following stem-rib to form a pair of ribs which each constitute further towards the external part a secondary pair by bifurcation. The short rib bifurcating from the straight paulostome rib, exceptionally high above the middle of the side, takes a forward bend which corresponds with the sigmoidal course, while the succeeding stem-rib which bifurcates lower than the paulostome rib is distinctly sigmoidal.

The marginal tubercles occur on the inner whorls regularly on each rib reaching the external margin, but they are only slightly developed and represented by thickening of the ribs. Further outwards on the outer whorls an alternation of the marginal tubercles occurs chiefly caused by the stronger swelling of each second rib.

With respect to the strength and closeness of the ribs on the sides, Figure 4 represents the mid-point between the extremes observed and Figure 3 shows the closest ribbing. The ribs in the middle of the external part are more or less distinctly interrupted. This depends upon whether the sculpture on the two halves of the shell exactly corresponds or not. Where the ribs distinctly alternate as in Fig. 5, the interruption in the middle of the external part is much more marked. At the more strongly swollen marginal tubercles it is not rare to meet with paired bifurcations of the ribs on the external part.

Satures.—Not known.

Dimensions.—These cannot be measured on account of the fragmentary state in which the specimens occur.

Locality and Geological Position.—In the dark slaty limestone of the Daonella beds of Lauka, number of specimens examined, 3; in the horizon No. 4 of the Daonella beds of the Bambanag Section, number of specimens examined, 1.

5. ISCULITES, E. v. Mojs., Cf. Cephalopoden der Hallstätter Kalke, Bd. II., p. 64.

1. ISCULITES HAUERINUS (Stol.).

1865. *Clydonites Hauerinus*, Stol., Mem. Geol. Survey of India, Vol. V, Part 1, p. 50, Pl. IV, Fig. 3.
1895. *Isculites Hauerinus*, Diener, Palæontologia Indica, Ser. XV, Vol. II, Trias, Part 2, p. 39, Pl. XXVII, Fig. 3; Pl. XXXI, Fig. 11.

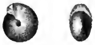
As already mentioned in the Introduction, it is not probable that this species belongs to the Anisic Stage. It is more probable that *Isculites Hauerinus* originated in a horizon of the upper trias. But as in the Mediterranean trias

Province the genus *Isculites* was found in the Carnic as well as in the Juvavian (Lacic) deposits, it is not possible to pronounce an opinion with reference to the occurrence of *Isculites Hauerinus* in any special horizon of the Indian trias; it must be left to further discoveries to solve the question.

2. ISCULITES cf. HEIMI, E. v. Mojs.

1893. *Isculites Heimi*, E. v. Mojs., Cephalopoden der Hallstätter Kalke, Bd. II, p. 67. Taf. LXXXVII, Figs. 8, 11, 12, 13.

This small shell, provided with a complete body-chamber whorl and mouth-margin, is related to the var. *obesa* of *Isculites Heimi*, from which it is only distinguished by its somewhat smaller dimensions. The expanding mouth-margin is well preserved. Near the aperture there are some transverse folds crossing the sides and the external part.



Isculites cf. Meimi (Natural size).

Sutures.—Not known.

Dimensions.—

Diameter	11	mm.
Height of the last whorl	4	„
Thickness „ „ „ „	7	„
Width of the umbilicus (at the opening)	3	„

Locality and Geological Position.—Carnic Stage; in the Crinoidal-Limestone with *Trachyceras tibeticum*, from Rimkin Paiar. Number of specimens examined, 1.

6. SAGENITES, E. v. Mojs., cf. Cephalopoden der Hallstätter Kalke, Bd. II, p. 155.

1. SAGENITES, n. f. ind., Pl. XI, Fig. 10.

The extraordinarily high-mouthed form here figured is unfortunately represented only by a single specimen whose preservation is not very favourable for investigation.

The whorls are more than twice as high as they are wide, and expanded, so that only a narrow umbilicus remains open provided with a rounded margin. The sides are flattened and incline from the umbilical margin, where the whorls reach their greatest width, towards the outer margin. The narrow external part is rounded. Obscure fold-like transverse ribs, running tolerably radially, are noticeable on the sides. On the external part they undergo an increase, mostly probably caused by bifurcation. No interruption of the sculpture seems to occur on the external part. The longitudinal ornamentation consists of faint broad longitudinal striæ, which are not evenly disposed, apparently a consequence of the state of preservation. The transverse as well as the longitudinal ornamentations are only very slightly developed, and the present species reminds us, on account of this feature, chiefly of *Sagenites inermis* (Cf. Cephalopoden der Hallstätter Kalke, Bd. II, Taf. 95 und 96).

Sutures.—The preservation of the sculpture did not permit of the suture-line being exposed more than had already been done by the breaking off of part of the shell in the anterior portion of the last whorl preserved.

There is a marked dolichophyll development of the sutures, somewhat as it occurs in the more strongly serrated Juvavian *Sagenites.* Besides the three principal saddles there may be still one or two auxiliary saddles outside the umbilical margin.

Dimensions.—

Diameter	66	mm.
Height of the last whorl	39	„
Thickness „ „ „	15	„
Width of the umbilicus	3	„

Locality and Geological Position.—Carnic Stage; in the Daonella beds of the Bambanag Section (No. 2). Number of specimens examined, 1.

2. SAGENITES, n. f. ind., Pl. X, fig. 6.

The figured completely-chambered fragment belongs, in all probability, to a new species, but on account of its incompleteness it is preferable to refrain from the imposition of a new specific name.

The penultimate whorl completely resembles a species from the group of *Sagenites inermis*, for it shows only fine transverse ribs but not yet any indication of longitudinal striation, which gradually gets strongly developed on the last whorl. The transverse ribs are also very well developed on the last whorl. They are distinguished by their sigmoidal curvature, as well as by the tendency to become stronger towards the external part which they traverse continuously. The division of the ribs does not often occur below the middle of the sides.

The external part is narrow. The greatest width of the volution is attained in the lower half. The umbilical margin is very sharply defined, the umbilical wall overhanging a little.

Sutures.—Of these only the large median projection of the external lobe, parts of the external saddle and of the first lateral lobe are visible. The last is distinguished by a larger median point, similar to that of *Sagenites princeps* and *Sagenites reticulatus.*

Dimensions.—Not measurable.

Locality and Geological Position.—Juvavian Stage; in the Limestone bed with *Pinacoceras* cf. *imperator*, No. 6 of the Bambanag Section. Number of specimens examined, 1.

3. SAGENITES, n. f. ind., Pl. X, Fig. 7.

The fragment of the external part here figured belongs to an undeterminable species which is related to *Sagenites quinquepunctatus* and *Sagenites Schaubachi*. A broad keel-like band occupying the middle of the external part, which is bounded on each side by narrower and feebler bands and ornamented with tubercles, distinguishes the present form from *Sagenites quiquepunctatus* (Ceph. d. Hallst. Kalke, II. Bd., p. 165, Taf. XCVII, Fig. 2, Taf. CXXV, Fig. 3), which in every other respect comes nearest to it, except that it is much thicker. Besides these external tubercles there occur other rows of tubercles, so far as the fragmentary state and the unfavourable condition of preservation permit of their recognition. The longitudinal striæ are very strongly developed, so that at their intersection with the transverse striæ little tubercles are here also formed.

The preceding whorl, judging by the mark of it in the zone of impression of the last whorl, seems not to have possessed any other kind of tubercles besides the small tubercles formed by the reticulations of the striæ.

Sutures.—Unknown in detail.

Dimensions.—Not measurable.

Locality and Geological Position.—The present fragment is derived from the beds (No. 9) rich in bivalves, at the base of the high mountain limestone of the Bambanag Section.

4. SAGENITES ind.

From the *Tropites*-Limestone of Kalapani there is a fragment of the side of a *Sagenites*, which might perhaps be placed near *Sagenites inermis* (Ceph. d. Hallst. Kalke, II. Bd., Taf. XCV, Figs. 2-5, 9-18, Taf. XCVI, Figs. 1-2). The fragment, however, is not sufficient to enable one to come to a tolerably certain decision even about its specific position. It seems, however, to point that the occurrence in the Tropites-Limestone of a form identical with *Sagenites inermis* or very nearly related to it is here indicated.

It should be further remarked that besides the few transverse ribs there are also faint traces of a longitudinal striation.

b. DIDYMITIDÆ.

DIDYMITES, E. v. Mojs.

1875. *Didymites*, E. v. Mojs., Das Gebirge um Hallstatt, Bd. I., p. 151.

This completely isolated genus was up to the present time reckoned among the Leiostraca. The globose shape of the shell, which shows a great analogy with

Proarcestes, its almost smooth surface and the strong development of epidermidae, seemed indeed to point that *Didymites* belonged to the same large group in which the similarly formed smooth shells, like the Arcestidæ (in the stricter sense) and the Joannitidæ are classed. But there are also many analogies with the Tropitidæ, so that the question may be raised whether *Didymites* should not perhaps more correctly find its place with the *Trachyostraca.*

In the first place the peculiar shape of the suture-line points to *Trachyostraca*, a fact to which Haug[1] has already directed attention. In spite of the considerable involution the number of the sutural elements is very small and their development is decidedly brachyphyll so that the habit on the whole approaches very much the sutures of *Trachyostraca* forms in the brachyphyll stage.[2] Only the peculiar development of the double saddles gives an unusual appearance to *Didymites* and reminds us of the dimeroid development of certain leiostracan types. But in some trachyostracan forms also similar secondary divisions are found; it is true, however, that they are only confined to the external saddle, as, for example, in *Tibetites.* A further peculiarity of *Didymites* is offered in the strongly developed lines of growth, which in their course remind us very much of the radial sculpture of true *Tropites*, whilst in the Arcestidæ and Joannitidæ the shells are mostly quite smooth and only show very faint traces of lines of growth.

Didymites would in the division of *Trachyostraca* certainly take up a very isolated position, but nevertheless views as to the possibility of a relationship to known types could there be more easily formed than in the division of the *Leiostraca*; for the Arcestidæ as well as the Joannitidæ already possess richly foliated sutures in the Anisic and the Fassanic periods. *Didymites* might have developed from the Haloritidæ by the gradual loss of the transverse sculpture and by the division of the saddles, and certain faintly ornamented Juvavitidæ, as, for instance, *Juvavites* (*Anatomites*) *Bacchus*, might be thought related to the ancestors of *Didymites*. From the experience gained up to the present time *Didymites* is confined to the Alaunic sub-division and can therefore be regarded as a very characteristic type of this period.

DIDYMITES AFGHANICUS, E. v. Mojs., Pl. XX, Fig. 9.

The spheroidal shell consists entirely of chambered whorls which are considerably wider than high and embrace one another up to the narrow umbilicus. The sides and external part seem to be equally inflated and not marked off from each other. The rate of increase of the whorls is very slow, and consequently the width of the umbilicus augments very slowly too.

The shell, which on the last whorl is damaged by weathering, is on the penultimate whorl almost smooth and only covered with indistinct transverse striæ. As mentioned above the shell is chambered throughout, and so the shape of the body-chamber whorl remains unknown until further discoveries are made.

[1] Bull. Soc. Géol. de France, 3 sér., Tom. XXII, p. 390.

[2] Cf. the sutures of *Juvavites* (*Anatomites*) *Bacchus*, Cephal. d. Hallst. Kalke, Bd. II., Taf. LXXXVII. Figs. 19-21.

Epidermidae.—A fractured place on the last whorl permits of the observation of extraordinarily fine transverse "wrinkle"-striæ on the surface of the penultimate whorl.

Sutures.—Up to the umbilical margin there are, on the whole, five saddles, of which the first three show the characteristic didymitic division. A strong double saddle, divided in the middle by a single deep pointed indentation, takes the place of the external saddle. The outer of the two branches—the one nearest to the external lobe—shows only a slight brachyphyll serration, whilst the inner branch shows more numerous serrations. The two following saddles are extraordinarily narrow, and only split into two in the middle of the upper portion by a shorter one-pointed indentation. The two succeeding smaller saddles directed towards the umbilical margin likewise possess a rectangular outline but are not divided above.

Among the *Didymites* of the Mediterranean Province *Didymites sphæroides* (E. v. Mojsisovics, Ceph. d. Hallst. Kalke, I. Bd., p. 153, Taf. LX, Fig. 10) may from the structure of the sutures be placed nearest to *Didymites afghanicus.* In the details, however, several differences are observed, especially in the third double saddle, which in *Didymites sphæroides* is distinctly broader and at the same time more deeply indented, as may be seen by a comparison of the figures.

Dimensions.—

Diameter	44 mm.
Height of the last whorl	17 „
Thickness „ „ „	25 „
Width of the umbilicus	4 „

Locality and Geological Position.—Found loose in a black limestone in the Mazarghan stream, about 7 miles south of Hindubágh, in the Zhob Valley (Baluchistan). Number of specimens examined, 1.

c. TROPITIDÆ.

1. Tropites, E. v. Mojs., Cf. Cephalopoden der Hallstätter Kalke, Bd. II, p. 184.

1. Tropites kalapanicus, E. v. Mojs., Pl. XI, Fig. 8.

This fossil, somewhat distorted by pressure in the rocks, possesses only a very slight remnant of the shell and in the greater part of the last whorl shows the body-chamber. It might therefore represent a tolerably complete adult specimen in which only about one-fifth or one-sixth of the body-chamber is wanting.

The whorls are of about equal height and width and increase proportionally slowly, whereby a tolerably wide umbilicus remains open. The external part is truncated and provided with a strongly developed keel sunk between keel-furrows.

The sides are somewhat inflated. The body-chamber is distinguished from the chambered part of the shell by the strikingly rapid appearance of a very strong development in the transverse sculpture. The chambered parts of the shell show a very close, fine sculpture of the type of ***Paratropites*** as in ***Tropites Sellai*** or ***Tropites Saturnus***, which at the beginning of the body-chamber quickly assumes the robust character mentioned above owing to the increase in width of the ribs and intercostal furrows. On the chambered parts of the shell three, sometimes perhaps also four, ribs on the sides correspond to one umbilical tubercle. On the body-chamber the ribs divide in pairs, as a rule, outside the umbilical tubercle. On the anterior part of the body-chamber single ribs also run undivided, and others only divide towards the middle of the sides. On the chambered shell as well as on the body-chamber the ribs on the sides show a slight curvature, convex anteriorly, which is so characteristic of the sub-genus ***Paratropites***. On the external part the ribs, strongly curved anteriorly, increase considerably in thickness.

Sutures.—The two lateral lobes with the brachyphyll developed saddles, represented in the illustration, are all that could be observed. This simple development of the suture-line is also characteristic of the sub-genus ***Paratropites*** (Cf. Ceph. d. Hallst. Kalke, II. Bd., p. 186).

Dimensions.—Cannot be measured on account of the distortion of the specimen.

Locality and Geological Position.—Carnic Stage; of the Tropites-Limestone of Kalapani. Number of specimens examined, 1.

2. TROPITES, n. f. ind., cf. acutangulus, E. v. Mojs., Pl. XI, Fig. 4.

1893. *Tropites acutangulus*, E. v. Mojs., Cephalopoden der Hallstätter Kalke, Bd. II, p. 203, Taf. CXII., Figs. 1, 2.

The figured specimen is apparently chambered up to the anterior broken edge, while a second specimen about a whorl larger seems to possess the body-chamber. Though these two specimens have suffered somewhat by distortion and are drawn out obliquely, they nevertheless show a close resemblance to ***Tropites acutangulus*** from which they are distinguished especially by the greater height of their mouth and their considerably narrower umbilicus. The sculpture is also nearly the same, as feeble longitudinal striæ are also indicated on the cast. But it may be mentioned as a distinction that in the present species the ribs become much thinner and run much further on the external part towards the anterior than is the case in ***Tropites acutangulus***. The curvature of the ribs on the sides is the same in both species. Bifurcations of the ribs occur regularly at the umbilical tubercle and sporadically also further out on the sides and even on the external part. The keel on the external part is accompanied by two strongly developed keel-furrows.

Sutures.—As the lateral saddle reaches to the umbilical margin the suture-line is to be regarded as deficient and the lobe coinciding with the umbilical margin is to be considered as first auxiliary lobe.

Dimensions.—Not measureable on account of the distortion of the shell.

Locality and Geological Position.—Carnic Stage; in the Tropites-Limestone of Kalapani. Number of specimens examined, 2.

3. Tropites, n. f. ind., Pl. XI, Fig. 6.

This chambered fragment belongs to all appearance to a species from the group of *Tropites fusobullatus*, which is distinguished by the regular occurrence of bifurcations of the ribs on the external part. A first pair of bifurcations of the ribs takes place at the very strong umbilical tubercles. After the second bifurcation, already attained on the external part, a very considerable bending forward of the narrow branched part of the ribs occurs. Keel-furrows are scarcely recognisable.

Sutures.—Not known.

Dimensions.—Not measureable.

Locality and Geological Position.—Carnic Stage; of the Tropites-Limestone of Kalapani. Number of specimens examined, 1.

4. Tropites, ind., cf. fusobullatus, E. v. Mojs., Pl. XI., Fig. 5.

1893. *Tropites fusobullatus*, E. v. Mojs., Cephalopoden der Hallstätter Kalke, Bd. II, p. 194. Taf. CIX., Figs. 1—3.

The figured fragment is distorted on the outer whorl by compression, and the strong inflation of the external part results from the schematic re-construction of the compressed external part. This arises especially from the circumstance that on the anterior broken edge the external part shows a much slighter inflation.

The present more or less damaged and deformed fragments, all casts, show a great resemblance in shape and sculpture to *Tropites fusobullatus* and point to this species or to one very closely related to it. The whorls are considerably thicker than they are high, and reach, still provided with septa, very large dimensions. Their attachment seems to take place, as in the typical *Tropites fusobullatus*, outside the umbilical tubercles. The bifurcations of the ribs occur at the thick strong umbilical tubercles. The keel on the external part is sunk between deep keel-furrows.

As there are only casts available, nothing can be said about the character of the shell, especially as to the occurrence of longitudinal lines; but to judge by the somewhat indistinct impressions on the cast, longitudinal lines, however, which crossed the transverse sculpture seem to have been present.

Sutures.—Through the distortion already mentioned the sutures also appear somewhat deformed. The striking height of the lateral saddle is especially remarkable. The similarly abnormal depth of the external lobe, which the illustration shows, could not be verified. The suture-line agrees in other respects with the typical sutures of the bullate *Tropites*.

Dimensions.—Not measurable.

Locality and Geological Position.—Carnic Stage; in the gray rusty-brown Tropites-Limestone of Kalapani. Number of specimens examined, 3-5.

5. Tropites, ind., cf. Tropites discobullatus, E. v. Mojs., Pl. XI, Fig. 7.

1893. *Tropites discobullatus*, E. v. Mojs., Cephalopoden der Hallstätter Kalke, Bd. II, p. 212, Taf. CIV; Taf. CV, Figs. 2-4, 7.

This fragment, chambered throughout, is not sufficient for an exact determination, and on account of its bad preservation it is only figured in the front view. It is closely related to the group of varieties of *Tropites discobullatus*, but it is not possible at present to establish the identity of the Indian fossil with the European species. It appears as if the present fragment were broken off at the boundary between the chambered part and the body-chamber, in which case it might be compared with the smaller European varieties of *Tropites discobullatus*.

Sutures.—Not known.

Dimensions.—Not measureable.

Locality and Geological Position.—Carnic Stage; of the Tropites-Limestone of Kalapani. Number of specimens examined, 1.

2. Styrites, E. v. Mojs.

1893. Cephalopoden der Hallstätter Kalke, Bd. II, p. 264.

1. Styrites, f. ind.

A cast in brown iron-stone, 10 mm. in diameter, comparable by its shape with *Styrites subniger* (Ceph. d. Hallst. Kalke, II Bd. p. 277, Taf. CXXI., Fig. 34), already possessing a body-chamber. The sutures are not known. The specimen comes from the lowest division of the Daonella beds (Nos. 1, 2) of the Bambanag Section.

2. Styrites, f. ind.

A cast in pyrites, 11 mm. in diameter, chambered nearly up to the anterior broken edge, near which the body-chamber begins. By its shape this specimen, somewhat distorted by compression, reminds us of *Styrites communis* (Ceph. d. Hallst. Kalke, II Bd., p. 273, Taf. CXXI., Figs. 9—14). The sutures, however, are somewhat flatter than in the present species and approach those of *Styrites vermetus* (*loc. cit.*, p. 280, Taf. CXXI, Fig. 25) and *Styrites collegialis* (*l. c.*, p. 287, Taf. CXXI, Fig. 26).

Like the above-mentioned *Styrites* the species here referred to comes likewise from the lower Daonella beds (Nos. 1, 2) of the Bambanag Section.

3. Eutomoceras, Hyatt, cf. Cephalopoden der Hallstätter Kalke, Bd. II, p. 273.

1. Eutomoceras, n. f. ind., cf. Eutomoceras Plinii, E. v. Mojs.

1893 *Eutomoceras Plinii*, E. v. Mojs., Cephalopoden der Hallstätter Kalke, Bd. II, p. 289, Taf. CXXI, Figs. 4—6.

From the grey crinoidal limestone with *Trachyceras tibeticum*, of Rimkin Paiar, a chambered cast, somewhat distorted and weathered, of 85 mm. in diameter, lies before me. This may be compared in the first place with *Eutomoceras Plinii*, but must be referred to another species on account of the deviations in the sutures.

The shape and the nature of the sculpture agree in essential points apparently with *Eutomoceras Plinii*, so that a description of them may here be omitted.

Sutures.—The external lobe is considerably shorter than the first lateral lobe. The external saddle therefore lacks the large accessory indentations on the slope turned towards the external lobe, which are so characteristic of *Eutomoceras Plinii.* The number of auxiliary lobes is very considerable. But in consequence of the changes which the suture-line has undergone through weathering it is not possible to determine exactly whether a part of the indentations may not be considered as divisions of the saddle.

A badly preserved, small, chambered fragment which comes from the Daonella beds succeeding the crinoidal limestone with *Trachyceras tibeticum*, near Rimkin Paiar, might also belong to this species.

2. EUTOMOCERAS, ind. cf. EUTOMOCERAS SANDLINGENSE, F. v. Hauer.

1893. *Eutomoceras Sandlingense* (Fr. v. Hauer), E. v. Mojs., Cephalopoden der Hallstätter Kalke, Bd. II., p. 285, Taf. CXXX., Figs. 11-13; Taf. CXXXI., Figs. 1-11.

These are fragments not suitable for illustration and are very similar to the narrow- as well as to the broadly-ribbed varieties of *Eutomoceras Sandlingense*; and it would, on account of their bad preservation, be impossible to give a more decided opinion as to their agreement with or deviation from the European type.

Locality and Geological Position.—In the Tropites-limestone of Kalapani.

d. SIBIRITIDÆ.

SIBIRITES, E. v. Mojs.

1886. *Sibirites*, E. v. Mojs., Arktische Triasfaunen. Mèm. de l'Acad. Imp. des Sciences de St. Pétersbourg, VII. sér., Tom. XXXIII., No. 6, p. 58.
1893. *Sibirites*, E. v. Mojs., Cephalopoden der Hallstätter Kalke, Bd. II., p. 327.
1895. *Sibirites*, Diener, Palæontologia Indica, Ser. XV., Himálayan Fossils, Vol. II, Trias, Part 2. The Cephalopoda of the Muschelkalk, pp. 37 and 104.
1895. *Sibirites*, Waagen, Palæontologia Indica, Ser. XIII, Salt Range Fossils, p. 104.

The species recently made known from the trias formations of the Salt Range, as well as from the trias of the Himálaya, increase our knowledge of this interesting genus to a considerable extent, so that it is necessary to enter anew into a discussion of it.

It must first be pointed out that owing to the species described by Waagen and Diener from the Dinaric deposits, the extent of the "Intermittent Period," as hitherto accepted on the ground of the knowledge yet possessed, is somewhat limited.

With the species described from the Olenek beds of Siberia are temporarily associated the numerous species of the Hydaspian Stage made known by Waagen from the Salt Range. The two species, *Sibirites Prahlada* and *Sibirites Pandya,* described by Diener from the Himálaya might be assigned to the Balatonian substage. The first named species comes from the chief zone of the Himálaya, whilst *Sibirites Pandya* was found in the red limestone of the Hallstatt development within the cliff regions of the Chitichun Chain in the Tibetan Province of Hundes.

The species of *Sibirites* of the Salt-Range though standing nearest to the Arctic species, *Sibirites Eichwaldi,* differ in many respects from the latter, so that they may be regarded as a characteristic group by reason of a tendency towards decided variation. To this group the sub-generic designation *Anasibirites* might be applied.

The species of *Anasibirites* is distinguished by narrow, rather rapidly increasing whorls, which possess a narrow, rounded or flattened external part. The ornamentation closes completely on the external part either describing a projecting external lappet (*Curvicostati,* Waagen) or traversing in a straight line the external part (*Rectecostati,* Waagen). Marginal tubercles are only faintly indicated in a few forms, but they are completely wanting in the greater number. The marginal tubercles never form raised edges, which make the middle region of the external part appear as a deepened furrow, as is the case with *Sibirites Eichwaldi.* In the lateral sculpture, the contrast between strongly developed chief ribs and weaker secondary ribs occurring in the interspaces of the chief ribs, which mostly appear as intercalated and more rarely as bifurcated ribs, is more or less striking. The tendency is thus shown to shift the place of division of the ribs from the margin towards the umbilicus. Where marginal tubercles are present they are only on the chief ribs. The lateral ribs show a tendency to curve sigmoidally, but in a few forms the curvature is only faintly indicated. The contrast between the primary and secondary ribs continues from the sides to the external part, in some species it being more sharply marked on the external part than on the sides. In a few species the sculpture disappears entirely on the body-chamber.

The two species described by Diener from the Anisian (Balatonian) deposits of the Himálaya are closely allied to *Sibirites pretiosus* and represent widely umbilicated, slowly increasing forms with low apertures, which also by reason of the the nature of the sculpture, are clearly distinguished from the forms designated as *Anasibirites* and may be considered, in all probability, as descendants of the *Pretiosus* stock. In *Sibirites Prahlada* (*loc. cit.*, p. 37, Taf. VII., Fig. 5), however, we already find a considerable approach to the types of the Lacic Hallstatt Limestone which we shall distinguish by the group-name *Metasibirites.* To *Metasibirites spinescens Sibirites Prahlada* has a particularly close resemblance. In the place of the lateral spines there are in *Sibirites Prahlada* strongly developed crescentic tubercles, at which, as at the lateral spines of *Metasibirites spinescens,* the bifurcation of the ribs takes place. In striking contrast with *Metasibirites spinescens* the bifurcated ribs of *Sibirites Prahlada* extend in an oblique direction from the crescentic tubercles to the external part, on which they describe an arch the convexity of which is directed forwards. The ribs on the external part are no longer in contrast to those of the older *Sibirites* of the Olenek beds closed together in a pointed angle, alternating from both sides of the shell in the middle of the external part, but they form uninterrupted continuous arches as in *Anasibirites*.

With reference to the second species, *viz.*, *S. Pandya* (*loc. cit.*, p. 104, Taf. XXIX, Fig. 3) described by Diener we must make a reservation, as the length of the body-chamber is not known. In spite of the fact that this species agrees very closely in shape and sculpture with *Metasibirites*, it does not seem certain whether we have not to recognise in *S. Pandya* a form branching off from *Danubites*, which should find its correct systematic position near *Buchites*. But should it be considered justifiable to refer *S. Pandya* to *Sibirites*, the position of the bifurcation of the ribs close to the edge would be a feature reminding us of *Sibirites pretiosus*. In the true *Metasibirites*, on the other hand, the bifurcations of the ribs occur as a rule at the lateral spines or, where these are already obliterated in the middle of the sides, even lower. The bifurcation of the ribs quite at the margin, however, is a feature which characterises the forms occurring in the Lacic deposits of the Himálaya, forms provided with large marginal spines and described in the following pages, for which I shall introduce the sub-generic designation of *Thetidites*.

The species of *Thetidites* are slowly increasing widely umbilicated shells, with low whorls of rectangular section. The inner whorls show an ornamentation which is distinguished from that of the inner whorls of the European species of *Metasibirites* only by the marginal position of the spines, whilst in the species of *Metasibirites* provided with an inflated external part the spines are lateral from their position. Later, when the sides have become more individualised in their development, there occur partly connected-ribs which close together in pairs at the marginal spines (*Th. Huxleyi*), partly accessory ribs running divergently (*Th. Guidonis*). The external part is covered with fine ribs, describing a very slight convexity directed anteriorly and being slightly interrupted in the middle line. The ribs, partly paired, form the connection between every two opposite marginal spines, but they partly also occur in the intervals between every two of the succeeding marginal spines.

The sutures of this peculiar type, reminding us by its sculpture of *Cœloceras subarmatum* from the lias, are distinguished from those of the older *Sibirites* by the great depth of the two-pointed external lobe. The first lateral lobe coincides with the marginal spines, while the one-pointed second lateral lobe is within or on the umbilical margin. There are no auxiliary lobes.

The sub-genus *Metasibirites* occurring in the Lacic formations of the Alps comprises throughout (as is to be seen in the illustrations in the second volume of the Hallstatt Cephalopoda) small shells of concentrated growth and sculpture, the latter traversing the external part in a straight line. The lateral tubercles or lateral spines always present in the young pass in some species into umbilical tubercles in adults, while in other species they disappear entirely. As in the sub-genus *Anasibirites* single ribs are often more conspicuous on the external part (paulostome-ribs).

The genus *Sibirites* is on the considerations above set forth thus divided into the following sub-genera:—

1. *Sibirites*, s. str. (Jakutic-Anisic).
2. *Anasibirites* (Hydaspic).
3. *Metasibirites* (Lacic in the Mediterranean Province).
4. *Thetidites* (Lacic, in the Indian Province).

Metasibirites and *Thetidites*, from our present knowledge of them, appear to us as vicarious genera. *Metasibirites* has not been proved to be present in the trias of the Himálaya and the reported occurrence of *Metasibirites spinescens* in the *Halorites*-beds of the section at Rimkin Paiar rests upon an error. The specimen which was taken for *Metasibirites* (*Acrochordiceras* of Griesbach) is so badly preserved that even a generic determination cannot be arrived at.

1. THETIDITES HUXLEYI, E. v. Mojs., Pl. XI., Fig. 12; Pl. XII, Figs. 1—4.

The slowly increasing whorls embrace one another only on the broad, slightly inflated external part. They are considerably wider than they are high and in the young possess sides which obliquely slope towards the widely open umbilicus, but are flattened in the adults, so that then a nearly rectangular section results. In consequence of this difference the umbilicus appears deeper in the young but much flatter in the adult.

The body-chamber comprises the whole of the last whorl, as is to be seen in the large full-grown specimen represented in Fig. 1, in which the last sutures, closely set, are shown.

On the inner whorls the most striking element of the sculpture consists in the high marginal spines which are placed at the edge between the sides, sloping obliquely towards the umbilical suture, and the broad slightly inflated external part. In connection with the spines there are on the sides, sloping obliquely towards the umbilical suture, straight radially running transverse ribs, which in most of the present specimens are broad and fold-like in their development. Only in such individuals (*e. g.*, Figure 4, Pl. XII) as reach maturity when of small dimensions the transverse ribs are already early present in the shape of well individualised fillets. The external part of such internal casts looks, at first sight, perfectly smooth, and it is only by very close observation that one can see obscure indications of the later strongly developed external ribs.

The marginal spines, of which from 11 to 13 may be counted, are closed in their lower portion at a little height above their base, near the lumen of the tube; and this is to be judged by the fact that spines broken off at this place are not bordered by an irregularly fractured cicatrice, but by a smooth lamella-like surface imbricated the reverse way. This surface evidently corresponds with the closure which separated the spine from the lumen of the tube. Whether this was merely a partition (in which case the spine must be supposed to have been hollow), or whether the whole spine was solid up to that surface, could not be ascertained.

The period at which the sides, after the development of a rounded umbilical margin from the obliquely sloping position, become converted into well individualised ones reaching to the umbilical margin, plays an important rôle in the development of the individual. But this period occurs at very different dimensions of the shell as the comparison of the two forms teaches. They are represented in Figs. 3 and 4, and form a great contrast in their development. The formerly simple lateral ribs bifurcate for the greater number and form connected-ribs which close together in pairs at the marginal spines. Moreover the sculpture on the external part becomes more distinct and prominent. The ribs traversing the external part with only a slight curvature directed anteriorly and showing a faint median longitudinal indentation in some specimens, occur partly between every two marginal spines opposite one another on the two halves of the shell and partly in the interspaces between every two succeeding marginal spines. These ribs appear in both cases as connected ribs bifurcating at the margin, or else closing again. A modification of this development occurs if three ribs join the corresponding marginal spines of the two halves of the shell. In this case and in others also the rib on the external part occurring between two succeeding marginal spines is not bifurcated but simple. Isolated undivided ribs, not connected with any marginal spine, occur also on the sides, especially towards the aperture.

Irregularly undulating longitudinal lines occur also in some specimens at the external part of the body-chamber.

The transformation in the sculpture and the shape of the shell takes place in most of the specimens on the septate penultimate whorl. Only in a few forms which are perhaps to be regarded as not yet full-grown this critical period coincides with the beginning of the body-chamber (Cf. Fig. 3, Pl. XII).

Sutures.—Corresponding with the conditions of involution no auxiliary lobes present outside the umbilical suture, and on the whole five lobes may be counted outside this suture, *viz.*, the two lateral lobes of the left and right half of the shell, and the external lobe. The latter is divided into two one-pointed halves by a short median projection. The succeeding first lateral lobe is almost halved by the external edge. In some specimens the larger half of it is already on the sides. The point of this lobe which does not reach as deep as the external lobe coincides almost always with the large marginal spines and is therefore with difficulty to be observed in detail. As a rule there seem to be two indentations from which a three-pointed arrangement results. The second lateral lobe lies on the umbilical margin, sometimes also inside of it. It is only one-pointed and considerably shallower than the first lateral lobe.

The one-pointed internal lobe forms a long narrow point. The saddles are rounded above and with unbroken edges. The external and lateral saddles show in their lower part faint indentations, which seem to be a continuation of the indentations of the lobes.

The variety in which the sides become individualised at a late stage of growth (Fig. 3, Pl. XL) is remarkable for its strikingly low saddles.

Dimensions.—

Diameter	42 mm.
Height of the last whorl	13·5 ,,
Thickness ,, ,, ,,	15 ,,
Width of the umbilicus	19·5 ,,

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 14.

2. THETIDITES GUIDONIS, E. v. Mojs., Pl. XI, Fig. 11.

This species is not only distinguished from the closely related *Thetidites Huxleyi* by the finer development of the sculpture, but also by other essential differences.

The internal cast, so far as it is visible in the umbilical opening, agrees with the internal casts of *Thetidites Huxleyi*, and like this species possesses simple, straight-running, lateral ribs and strong marginal spines. The sides also, as in the inner whorls of the species just named, slope obliquely towards the umbilical suture. But when compared with *Thetidites Huxleyi* there is here already a distinction to be noticed in so far as the marginal spines are weaker, finer and therefore also more numerous. A rounded umbilical margin which bounds the now individualised flattened sides towards the umbilicus is early formed.

But in contrast to *Thetidites Huxleyi* there are no connected ribs on the individualised sides. On the contrary, peculiar intercalations of ribs are shown which at first sight produce the impression of bifurcations. There appears, namely, close to the preceding radially-running chief rib, an accessory one, but already completely separated at the umbilical suture. Outside the umbilical margin, after a slight backward curvature, it turns, diverges strongly in an oblique direction towards the anterior and bears on the outer edge a marginal spine like those of the chief ribs.

The diverging ribs just described only occur alternately at irregular distances. There are about two simple ribs in the interspaces.

On the last whorl, forming the body-chamber, the diverging pairs of ribs gradually disappear. The numerous fine ribs, separated by broad intercostal furrows, are of varying strength and slightly concave towards the anterior. The marginal spines become feebler in the stronger ribs, disappearing entirely in the weaker ones. In the anterior part of the last whorl the sculpture becomes irregularly folded and true divisions of the ribs also occur.

The sculpture on the external part is of the same kind as that described in *Thetidites Huxleyi*, but with this difference, namely, that in ribs lacking the marginal spines no external divisions of the ribs take place.

Sutures.—The suture-line does not only agree in the general arrangement but also in the essential features with the sutures of *Thetidites Huxleyi*. Slight indentations are visible in the lower part of the walls of the external saddle and of the lateral one.

Dimensions.—

Diameter	34 mm.
Height of the last whorl	10·5 ,,
Thickness ,, ,, ,,	12 ,,
Width of the umbilicus	15·5 ,,

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 1.

B. CERATITOIDEA.

a. DINARITIDÆ.

1. DINARITEA.

1. Ceratites, de Haan.

Ceratites is only represented by the subgenera *Helictites* and *Thisbites*, but it must be mentioned that the determination of the genus *Thisbites* is for the present still doubtful.

a. Helictites, E. v. Mojs., cf. Cephalopoden der Hallstätter Kalke, Bd. II., p. 416.

Helictites atalanta, E. v. Mojs., Pl. XII, Fig. 5.

The widely umbilicated shell consists of rather quickly increasing whorls which are somewhat wider than high and embrace one another on the rounded external part. The sides are moderately inflated. In the transverse section of the whorls there is a great resemblance to *Helictites*, nov. f. ind. (Cephalopoden der Hallstätter Kalke, Bd. II., p. 420, Taf. CXXXIX, Fig. 2) from the Lacic Limestone of Leisling near Goisern, whilst the sculpture shows a close agreement with *Helictites Beneckei* (*loc. cit.*, p. 416, Taf. CXXXIX, Fig. 1) coming from the same horizon.

On the chambered whorls generally two of the slightly curved strong ribs, whose concavity is turned anteriorly, run in pairs together and form strong umbilical tubercles. The intercostal furrows seem to be tolerably wide on the cast. On the external part of the last whorl, three-fourths of which belong to the body-chamber, the ribs are close together, slightly curved towards the anterior part. Indistinct marginal and externally situated tubercles, which disappear entirely on the body-chamber, are to be observed on the still chambered posterior part of the last whorl in a symmetrical arrangement. There are indications of two rows of marginal tubercles, while, on the external part, outside its median line, towards the left, a row of knot-like swellings is noticeable.

Marginal and external tubercles have likewise been observed in the Mediterranean species ***Helictites geniculatus.*** As the ribbing of the two halves of the shell is not completely symmetrical the closing together of two ribs of the one half of the shell with only one rib of the other half takes place on the external part.

The ribs are wide apart on the body-chamber. The knot-like swellings on the umbilical margin persist nearly up to the mouth, where they disappear, but the paired divisions have ceased, and in their place, as the bifurcations advance on the sides, obscure bifurcations of the ribs occur, which assume the character of intercalations of secondary ribs.

Behind the margin of the mouth the considerably weakened fold-like ribs become crowded. Indications of faint spiral striæ are visible on the cast of the body-chamber.

Sutures.—External lobe deep, only a little shorter than the first lateral lobe, divided by a median projection rounded above and with an unbroken margin into two halves, notched into three points by two small indentations.

The first lateral lobe deep, considerably widening towards the upper part, two-pointed at the base by a median indentation, whilst a shorter point on either side inserts itself into the walls of the neighbouring saddles.

Second lateral lobe considerably shorter than the first, divided at the base into two points, coinciding by its position with the umbilical tubercle.

Saddles with an unbroken margin, rounded above. External saddle nearly as high as the first lateral saddle, slightly flattened above. The second lateral saddle sinks downwards on the umbilical wall.

Dimensions.—

Diameter	48 mm.
Height of the last whorl	16·5 „
Thickness „ „ „	17·5 „
Width of the umbilicus	19 „

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 1.

b. THISBITES, E. v. Mojs., Cf. Cephalopoden der Hallstätter Kalke, Bd. II, p. 429.

THISBITES (?) MELEAGRI, E. v. Mojs., Pl. XIV, Fig. 10.

Some difficulties present themselves in assigning this isolated form to its systematic position in one of the known genera. *Eutomoceras* is distinguished by the early beginning of the bifurcations of the ribs, and their slight curvature. In the genus *Thisbites,* distinguished likewise by a high external keel, marginal tubercles or lunulæ taking their place as a rule occur. But among the European representatives of this genus there are some species in which marginal tubercles as well as lunulæ are wanting, as, for instance, *Thisbites Borellii* and

Thisbites, nov. f. ind. (Cephal. d. Hallst. K., II Bd., p. 435, Taf. CXLII, Fig. 24). From Europe also *Thisbites* is known, in which, as in the present species, no bifurcations of any kind, or intercalations of ribs, occur, as, for instance, *Thisbites Haushoferi* (Cephal. d. Hallst. K., II Bd., p. 440, Taf. CXLII., Fig. 26). The habit of the present Asiatic form reminds us of the latter species, as well as of *Thisbites Anatolis* and *Thisbites Borni*, so that with the reservation demanded by the circumstances of the case we place it in *Thisbites*, without of course intending to exclude the possibility that we may perhaps have to deal here with a new genus.

The small shell is somewhat elongated, but we cannot decide whether this is due to a mechanical contortion of the rocks, or it is a character originally belonging to the species. The whorls are considerably higher than they are wide. They increase rapidly in height and embrace one another to the extent of about one half. The width of the umbilicus amounts to somewhat less than half the height of the whorl at the mouth of the last whorl. The inflated sides converge gradually towards the pointed external part, to which the high external keel seems to be applied. The keel is well individualised and not distinctly defined at its base.

The lateral sculpture consists of strong sickle-shaped ribs which run out on the external part thin and thread-like to the next succeeding rib, touching this latter, so that a continuous spiral line is formed in which the ribs meet. At the beginning of the last whorl the ribs are crowded. Later they are, however, wider apart, so that at the end of the last whorl wide intercostal areas occur. The ribs remain, as a rule, undivided. Only quite exceptionally bifurcations of the ribs occur near the umbilical margin.

Sutures.—Not known.

Dimensions.—

Diameter	14·5	mm.
Height of the last whorl	7·5	„
Thickness „ „	4	„
Width of the umbilicus	2·8	„

Locality and Geological Position.—Carnic Stage; in black limestone, on the left side of Tera Gadh, North of Kalapani. Number of specimens examined, 1.

2. ARPADITES, E. v. Mojs., Cf. Cephalopoden der Hallstätter Kalke, Bd. II, p. 450.

Of the eight sub-genera, which I have elsewhere identified, I could only establish five in the Indian trias. They are as follow:—

a. *Arpadites*, s. str.
b. *Dittmarites*.
c. *Clionites*.
d. *Steinmannites*.
e. *Dionites*.

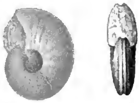
The genus *Arpadites* is in the wider sense a polyphyletic one which can be traced back to different *Ceratites* stocks. As soon as the appropriate *Ceratites* stock can be established for each single genus the genus *Arpadites* will be given up, and the genera into which it is divided will then be arranged according to their respective places in the system.

a. ARPADITES, s. str.

1. Arpadites Stracheyi, E. v. Mojs.

1865. *Ammonites floridus* (Wulfen) juv., Salter, Palæontology of Niti, p. 61, Pl. 8, Fig. 3 (but not Figs. 1, 2, and not Pl. 6, Fig. 1.)

A plaster model of Salter's original specimen preserved in the British Museum in London has been kindly placed at my disposal by Dr. Henry Woodward, and enables me to give here an illustration in its natural size of this very simple shell.



Arpadites Stracheyi.

From a plaster model of the original specimen from the Niti Pass. Natural size.

The whorls, embracing one another to the extent of about one half of their depth, are higher than they are wide and possess slightly inflated sides. The external furrow at the beginning of the last whorl is deeply sunk into the rounded smooth external part. But gradually the edges of the furrow, greatly increasing in width, rise into strong broad keels. The more marked individualisation of the external part through the presence of blunted marginal edges which separate the sides from the external part takes place simultaneously with the development of the keels.

The lateral sculpture is confined to slight indications of transverse folds which seem to arise through the scooping out of shallow depressions round the umbilicus, a circumstance whereby we are reminded of the process of construction of the ribs in the group *Arpadites rimosi* (cf. Ceph. d. Hallst. Kalke, Bd. II, Taf. CLIV, Figs. 2, 6; Taf. CLV., Fig. 1; Ceph. d. medit. Triasprovinz, Taf. XXV, Fig. 6). Indications of smaller, slightly curved, transverse folds are noticeable on the anterior half of the last whorl. The shell possesses an obliquely elliptical outline.

Sutures.—According to the figure of the suture-line given by Salter there are saddles with unbroken margin, rounded above, and rather flat lateral lobes with many indentations. Salter figures the external lobe only two pointed, indicating only one divergent point of the lobe on either side of the very rudimentarily-developed median projection. A flat hollowed-out auxiliary lobe with unbroken margin appears outside the umbilical edge.

Dimensions.—

Diameter	26	mm.
Height of the last whorl	11·5	,,
Thickness ,, ,,	8	,,
Width of the umbilicus	6·5	,,

Locality and Geological Position.—Carnic Stage; Niti Pass.

2. Arpadites rimkinensis, E. v. Mojs., Pl. XIV, Fig. 6.

This species represents a circumplicated type, not known up to the present in the Mediterranean trias region, which is distinguished from the most closely related group of forms of *Arpadites cinensis* (Ceph. d. medit. Triasprovinz, p. 56 f.) by the lack of umbilical tubercles.

The whorls, rather rapidly increasing in height, embrace one another to the extent of rather more than half their height. They are higher than they are wide. The sides are moderately inflated. The external part bears two high sharply defined keels which enclose the deep-sunk middle furrow.

The sculpture consists of narrow ribs succeeding one another at wide intervals. They are strongly raised as long as they radiate in a straight line, but they are much more feebly developed farther outside, where they distinctly bend towards the anterior part. In the wide interspaces between these strong ribs of which fifteen are present in the circumference of the last whorl, more feebly indicated secondary ribs occur, which are mostly to be regarded as intercalated ribs and only exceptionally as bifurcated ones. But the strength of the ribbing is subject to some variations, as in some specimens the intercalated secondary ribs almost reach the strength of the primary ribs, so that the shell then appears in this variety much more closely ribbed. At a diameter of 20 mm. a specimen of this variety bears 20 ribs in the circumference of the last whorl.

Sutures.—The sutures have a brachyphyll development in contrast to those of the group of *Arpadites cinensis* in the ceratitic stage of development and may be compared with the sutures of *Arpadites Ladon* (Ceph. d Hallst. Kalke, II. Bd. Taf. CLIII., Figs. 6—7) from the Julian deposits, but the second lateral lobe is considerably deeper in *Arpadites rimkinensis* than in the species named above. The first auxiliary lobe is on the umbilical margin.

Dimensions.—

Diameter	23	mm.
Height of the last whorl	10·5	,,
Thickness ,, ,, ,,	6	,,
Width of the umbilicus	5·9	,,

Locality and Geological Position.—Carnic Stage; in the crinoidal limestone of Rimkin Paiar. Number of specimens examined, 7.

3. Arpadites lissarensis, E. v. Mojs., Pl. XIV, Fig. 7.

The figured specimen which is distinguished by an obliquely elliptical oviform outline, represents a type which might find its natural alliance in the Mediterranean group of *Arpadites Arpadis*. The slight depth of the external furrow, accompanied by constantly occurring marginal spines, gives however a certain isolated position to the present species.

The whorls embrace one another only on the slightly inflated, rather flattened external part; they increase very slowly, so that in the widely opened umbilicus the whole height of the sides of the inner whorls is visible. The whorls are thus higher than wide.

The feebly developed external furrow is sunk in a broad keel-like longitudinal elevation of the external part, similar to that of *Steinmannites thisbitiformis* (Ceph. d. Hallst. Kalke, II. Bd., p. 484, Taf. CXLII, Figs. 7, 8).

The transverse sculpture is only feebly indicated on the inner whorls by flat indistinct folds. On the penultimate whorl the present fragment shows faint slightly curved ribs which are separated by wide intercostal spaces bearing small umbilical tubercles on the umbilical margin. In some cases two neighbouring ribs furcate at these tubercles, that is, weaker secondary ribs separate themselves from the stronger primary ribs. At the edge of the periphery all the ribs bear spines, from which the considerably weakened ribs on the external part bend obliquely forward, describing a short lappet. In traversing the keels which enclose the external furrow, the ribs form obscure tubercles.

On the outer whorl which in this fragment belongs to the body-chamber, small bifurcations of the ribs are shown. The ribs are considerably more closely set in the anterior part.

Sutures.—Not known in detail.

Dimensions.—

Diameter	35 mm.
Height of the last whorl	8·5 „
Thickness „ „ „	5 „
Width of the umbilicus, about	19 „

Locality and Geological Position.—Carnic stage; in grey limestone with *Joannites*, cf. *cymbiformis*, of the Lissar Valley, opposite the Ralphu Glacier. Number of specimens examined, 1.

b. DITTMARITES.

Arpadites (Dittmarites) Hindei, E. v. Mojs., Pl. XIV, Fig. 8.

As to this species one might, on account of its outward similarity to *Anasirenites Aristotelis* (Ceph. d. Hallst. Kalke, II. Bd., p. 780, Taf. CLII., Fig. 1), be in doubt whether to refer it to *Anasirenites* or to *Arpadites*. It is the group of *Arpadites rimosi* (sub-genus *Dittmarites*) in the genus *Arpadites* to which the present species seems closely related. The reasons that induce us to give the preference to the latter alternative are—(1) the flattened character of the transverse ribs, which are only separated from one another by narrow sharply-cut intercostal furrows; (2) the agreement in character of the umbilical margin with the group of *Arpadites rimosi* in contrast to the gently sloping umbilical area of *Anasirenites Aristotelis*; and (3) the absence of the longitudinal line occurring in the last-named species in the middle of the sides. *Arpadites Hindei* is in its entire habit allied to *Arpadites Ferdinandi* (Ceph. d. Hallst. Kalke, II. Bd., p. 459, Taf. CLIII., Figs. 15, 17), but has a much higher mouth and is more narrowly umbilicated. The external part is flatter, which is chiefly caused by the lesser height of the smooth external keels. The sides are covered with much more numerous, distinctly sigmoidally-curved ribs which form bundles at the tubercles on the umbilical margin. Through further bifurcations of the ribs occurring at less than half the height of the sides the number of ribs united to a bundle amounts to from 4 to 5. At the edge bordering the smooth external area from which the keels rise, the ribs become pointed. The occurrence of umbilical tubercles is repeated in the only species known up to the present time from the Juvavian formation, *viz.*, *Arpadites Lilli* (Ceph. d. Hallst. Kalke, II. Bd., p. 462, Taf. CLIII., Fig. 10.)

The great morphological agreement with *Anasirenites Aristotelis* above emphasized might lead one to think as to whether this species might not find a more suitable systematic position in *Arpadites*. But while the occurrence, as already mentioned, of the longitudinal line in the middle of the side is a feature which is foreign to *Arpadites*, it may on the other hand be frequently observed in *Anasirenites*. And also while the peculiar division of the external saddle in *Anasirenites Aristotelis* is absent in *Arpadites*, its presence has already been proved in *Sirenites*, which is closely related to *Anasirenites*. Thus we are led to trace back the resemblance between *Anasirenites Aristotelis* and *Arpadites Hindei* to convergent development of different stocks.

Sutures.—Unfortunately it was not possible to obtain a connected suture-line. The type of the sutures stands on the border line between brachyphyll and dolichophyll development. The saddles, which show a pyramidal outline, are of considerable height. The first lateral lobe is divided into three points.

Dimensions.—

Diameter	33 mm.
Height of the last whorl	17·5 „
Thickness „ „ „	8 „
Width of the umbilicus	3·3 „

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 1.

c. CLIONITES.

1. CLIONITES WOODWARDI, E. v. Mojs., Pl. XIII, Figs. 4, 5.

I regard as the type of the species the narrower specimen illustrated in Fig. 4, whilst distinguishing the broader one, Fig. 5, as *varietas crassa*. In both cases the whorls are higher than wide and embrace one another only on the external part.

The *varietas crassa*, however, increases a little more rapidly and appears therefore somewhat more narrowly umbilicated than the typical form.

The sides are rather flat and bordered by a distinctly marked umbilical margin. The umbilical wall descends steeply to the umbilical suture. The external part is inflated. The external furrow is not excavated in the shell, but only formed by the two rows of external tubercles greatly lengthened at the base spirally. The sculpture consists of strong ribs ornamented with five rows of tubercles, and a very faint longitudinal striation.

The narrow ribs, running in a tolerably straight direction up to the marginal tubercles and then obliquely turning towards the anterior, are separated by wide intercostal spaces. Bifurcations of the ribs occur on the umbilical tubercles as well as on the marginal ones. Some ribs, however, run also undivided.

Between the marginal and the umbilical tubercles there occurs situated nearest to the marginal ones another row of lateral tubercles, which is more strongly developed on the inner whorls and becomes considerably weakened on the last, still chambered whorl. A further row of tubercles is placed on the external part in the middle, between the marginal and external tubercles. These outer rows of tubercles are strongly developed and take almost the character of elongated external spines. In the variety *crassa* some tubercles become, however, flattened in the anterior part of the last whorl and have almost the appearance of the elongated external tubercles occurring on the body-chamber of *Clionites aberrans*.

Sutures.—The second lateral lobe coincides with the umbilical tubercles. The external lobe is lower than the first lateral lobe and divided into three-pointed halves by a very low broad median projection. First lateral lobe narrow and deep, divided into three points at the base; second lateral lobe considerably shorter, three-pointed at the base like the first. In the typical form there arise from the lateral lobes, joining the denticulations of the lobes, two notches or only one at the outer saddle wall. Also in the variety *crassa* there are on the last septa notches on the wall of the external saddle which is directed towards the lateral lobe. Saddles with unbroken margin, rounded above. External saddle considerably higher than the first lateral saddle. The second, very low lateral saddle, descends on the umbilical wall to the suture.

Dimensions.—

	I.	II. *Var. crassa.*
Diameter	49 mm.	53 mm.
Height of the last whorl	17·5 ,,	20 ,,
Thickness ,, ,, ,, ,, ...	12·5 ,,	18 ,,
Width of the umbilicus	20 ,,	19 ,,

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 6.

2. CLIONITES SALTERI, E. v. Mojs., Pl. XIII, Figs. 6, 7.

This species, closely related to *Clionites Woodwardi*, is distinguished by slowly increasing whorls, which are wider than high. I consider the specimen illustrated in Fig. 6 as the type, from which the variety, Fig. 7, is distinguished by more crowded and more numerous ribs, as well as by slight differences in the structure of the sutures. The transverse sculpture agrees in the principal features with that of *Clionites Woodwardi*. It is chiefly distinguished by the oblique, backwardly directed ribs on the sides, and also by the external ribs running in a straight direction from the marginal to the external tubercles. In the typical form there occurs an early weakening of the tubercles, especially of the lateral tubercles and of the row of tubercles intercalated between the marginal and external tubercles. Spiral striation was not observed.

Sutures.—The second lateral lobe stands inside the umbilical margin already on the umbilical wall in the typical specimen, whilst in the variety, distinguished by closer ribbing, the second lateral lobe coincides with the umbilical margin. The external lobe almost attains the depth of the first lateral lobe. It is divided into two- to three-pointed halves by a small median projection without denticulations. The first lateral lobe is four-pointed. The two middle points in the typical form are considerably larger than the neighbouring lateral ones, whilst the points in the closely ribbed variety almost attain the same size. The indication of a fifth point in this variety is sometimes observable.

The second lateral lobe is two-pointed; the saddles, with unbroken margin, are somewhat higher and narrower in the type specimen, but in the variety they are lower and broader. The external saddle and the first lateral one possess, approximately, the same height. The second lateral saddle on the umbilical wall is only rudimentarily developed.

Dimensions.—

Diameter	38 mm.
Height of the last whorl	12 „
Thickness „ „ „	15
Width of the umbilicus	16 „

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 4.

3. CLIONITES ABERRANS, E. v. Mojs., Pl. XIII, Fig. 8.

The inner whorls agree with those of *Clionites Woodwardi* and also possess the longitudinal striation which is observed in *Clionites Woodwardi*. The outer whorl which in the present fragment belongs entirely to the body-chamber, shows a kind of sculpture considerably differing from that of the inner whorl and reminding us of the sculpture of *Protachyceras Thous*, Dtm.[1] That this is only an outward resemblance resting upon a chance assemblage of characters is shown by the entirely different modes of development of the two species, which can be observed in the inner whorls. *Clionites aberrans* agrees, as mentioned above, in the inner whorls with *Clionites Woodwardi*, whilst the inner whorls of *Protrachyceras Thous* are like the outer.

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[1] E. v. Mojsisovics, Cephalopoden der Hallstätter Kalke, Bd. II., p. 629, Taf. CLXVIII, Figs. 2—11.

The differences which the body-chamber of *Clionites aberrans* shows are as follow.—The transverse ribs appear to be slightly sigmoidally curved. They have become fold-like and striated and in some places entirely converted into striæ. Of the five spiral tubercles only the umbilical, marginal and external ones are distinctly developed, whilst the lateral row of tubercles is scarcely even indicated. The row of tubercles between the marginal and external tubercles is a little better preserved, but these tubercles only appear somewhat lengthened spirally. The most striking change is noticeable in the external tubercles which now appear as rounded keel-tubercles, greatly elongated spirally. In the description of variety *crassa* of *Clionites Woodwardi* the unique change of the normal external tubercles into such elongated tubercles has been mentioned.

A further feature of the difference in the body-chamber is the restriction of the bifurcations of the ribs to the region of the umbilical tubercles.

Sutures.—Not known in detail.

Dimensions.—The fragmentary condition of the specimen does not allow of measurements of its parts.

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 1.

4. Clionites Hughesi, E. v. Mojs., Pl. XIV, Figs. 1—3.

This type is subject to some variations which are indicated in our illustrations; such variations are best regarded as characterizing varieties of a species, as the variations observable do not appear to be sufficient to admit of their being considered as constituting special species.

The type specimen, Fig. 1, possesses slowly increasing whorls, embracing one another on the external part. The whorls are wider than high in the young, but on the body-chamber somewhat higher than wide, leaving a wide umbilicus open.

The sculpture shows the same elements as *Clionites Woodwardi* and *Clionites Salteri* and is on the inner whorls considered also to be already highly developed, as the transverse ribs appear to be finely wrought; they stand close together and five rows of spiral tubercles are present. On the last whorl, which for the greater part belongs to the body-chamber, the more widely separated numerous ribs assume a slightly sigmoidal curvature and the lateral tubercles disappear nearly completely, whilst the other rows of tubercles become also visibly weaker. The increase of the ribs occurring in the anterior part of the body-chamber takes the character of intercalations.

In proportion to the weakening of the tubercles on the external part the external furrow becomes less conspicuous. The transverse sculpture closes gradually together, traversing continuously the external part.

Where the shell is well preserved, strong inversely imbricated lines of growth, which are crossed by much more feebly indicated and obscure longitudinal lines, are to be seen.

The specimen represented in Fig. 2 is chiefly distinguished from the typical form by the less curved course of the transverse ribs on the body-chamber whorl, as also by the fact that the weaker ribs mostly reach to the umbilical margin. Sometimes these secondary ribs, corresponding to the intercalated ribs of the type form, also show faint traces of umbilical tubercles. The external sculpture occurs also in this variety only in the anterior part of the body-chamber, coming from both halves of the shell and terminating at the external tubercles, while in the foremost part of the body-chamber the ribs meet over the disappearing external furrow.

The form with the body-chamber represented in Fig. 3 might be regarded as that of an immature individual, if the obliteration of the lateral tubercles did not indicate that the mature stage had already been reached. Besides being smaller this specimen is distinguished by a slight inflation of the sides and by the almost complete obliteration of the umbilical tubercles. With reference to the ribbing it stands between the specimens represented in Figures 1 and 2. Though a weakening of the tubercles likewise occurs on the external part, no meeting of the lateral sculpture takes place across this part.

Sutures.—External lobe very deep and in line with the first lateral lobe; the two halves two-pointed. First lateral lobe four-pointed. The two middle points reach a somewhat greater depth than the lateral ones. The second lateral lobe which is two-pointed, is situated on the umbilical margin. External saddle somewhat weaker than the first lateral saddle. Both are about the same height, with an unbroken margin, and rounded above.

Dimensions.—

Diameter	44	mm.
Height of the last whorl	15	„
Thickness „ „ „	14	„
Width of the umbilicus	18	„

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 4.

5. Clionites, n. f. ind., P. XIV, Fig. 4.

The specimen figured, broken as it is at the beginning of the body-chamber, is closely related to *Clionites Hughesi*, with which it agrees in reference to its shape and the nature of its sculpture. It is, however, so distinct from the more closely ribbed *Clionites Hughesi* by the separation of the ribs by a greater distance on the outer whorls, especially at the beginning of the body-chamber, and the considerable thickening of the latter connected therewith, that it can no more be placed in the group of varieties of this species. If we take into consideration that on specimens with more complete body-chambers, the always strongly developed ribs must give to the species a habit which represents a mode of variation entirely opposed to that of *Clionites Hughesi*, the independent position of the present form cannot well be doubted.

Sutures.—The suture-line shows close agreement with that of *Clionites Hughesi.* The external lobe, however, attains a greater depth than the first lateral lobe, which reaches a greater width than that of *Clionites Hughesi.* The external saddle is somewhat higher than the first lateral saddle.

Dimensions.—

Diameter	41	mm.
Height of the last whorl	13·5	,,
Thickness ,, ,, ,,	12·5	,,
Width of the umbilicus	17	,,

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 1.

6. CLIONITES SPINOSUS, E. v. Mojs., Pl. XIV, Fig. 5.

The shell, only slightly embracing, is, when compared with species occurring in the same bed, distinguished by the permanence of the tubercles which increase in strength and almost become spines. Besides the usual five rows of tubercles which distinguish the related Indian species, there occurs on the body-chamber whorl also the indication of a new intercalated sixth spiral, which appears on the sides between the umbilical and lateral tubercles already occurring on the inner whorls.

A further peculiarity of *Clionites spinosus* lies in the irregular character of the bifurcation and connection of the ribs. For instance, the connection of the ribs on the sides occurs not rarely on the marginal tubercles. The strength of the ribs is to a certain extent disproportionate to the extreme development of the spine-like tubercles.

The lines of growth are distinctly developed. They are crossed by less conspicuous longitudinal striæ. The latter are strongest on the external part of the body-chamber. The spirally elongated external tubercles unite at the base in the same manner as the external keels.

Sutures.—Not known in detail.

Dimensions.—

Diameter	31	mm.
Height of the last whorl	11·5	,,
Thickness ,, ,, ,,	11	,,
Width of the umbilicus	13	,,

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 2.

d. STEINMANNITES.

1. STEINMANNITES UNDULATOSTRIATUS, E. v. Mojs., Pl. XIII, Fig. 1.

The widely umbilicated shell consists of slowly increasing whorls, embracing one another only on the external part. They are higher than they are wide and possess a rectangular transverse section. The umbilicus as well as the external margin are sharply defined by the umbilical and marginal tubercles. The strongly developed external keels, which are accompanied by faint keel-furrows losing themselves in the anterior part of the last whorl, rise high above the truncated external part. They enclose the external furrow which is distinguished by its great width.

In the sculpture of the chambered whorls there are to be distinguished two systems apparently independent of each other, namely, (1) the transverse sculpture, and (2) the quite peculiar longitudinal striation crossing the transverse ribs, which, it must especially be pointed out, is not to be confounded with the epidermidæ, belonging as it does to the shell itself, impressing it so that the striation is visible on the cast.

The longitudinal striation, which is strongly developed on the inner whorls and gradually weakens on the outer whorls till it completely disappears, is distinguished from a normal longitudinal striation by the fact that it is arranged in undulating arches cutting the transverse sculpture not vertically but diagonally, and at certain intervals, passing from the longitudinal direction into the transverse, bending outwards towards the external margin. Thus the longitudinal striation, according to the species, is divided into a varying number of divisions, each of which has the same undulating course. A flat arch convex towards the outer side is succeeded by a larger arch concave towards the outer side, whose longer anterior portion assumes a transverse direction. These peculiar striæ do not exist at the lower part of the sides, but they begin somewhat higher, below the middle of the sides. The foremost striæ of each division, transversely directed towards the outer side, are distinguished by greater fineness and are somewhat closer. The number of divisions occurring in the circumference of the last chambered whorl amounts to five in *Steinmannites undulatostriatus.*

A very characteristic peculiarity of the transverse sculpture, which seems to stand in a certain relation with the undulato-striate longitudinal sculpture, must be emphasized and not remain unnoticed in a description of the latter. It is that the occurrence of typical marginal lunulæ coincides with the outwardly concave arches of each division. A tubercular thickening is connected with the lunulæ.[1] It is now remarkable that only one lunular tubercle occurs on each division, whilst the remaining ribs, without forming a marginal tubercle pass over on to the external side. After the disappearance of the undulating longitudinal striation the marginal lunular tubercles also cease and in their place there appear marginal tubercles regularly on all the ribs.

The very strong transverse sculpture shows ribs wide apart from one another, which at shorter or longer intervals bear strong tubercles on the umbilical margin. Two neighbouring ribs then mostly join fork-like together at these tubercles. Those ribs which carry no umbilical tubercles are more feebly developed and undergo, as a rule, no furcation. The radial course of the ribs is tolerably straight. The ribs forming an external lappet in their course only bend forward on the external part producing the tuberculation on the external keels.

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[1] Lunulæ occur especially in the *Ceratites* genus *Thisbites* (Ceph. d. Hallst. Kalke, Bd. II, p. 399) and in the Arctic group of *Ceratites geminati*, probably connected with this genus.

Faint traces of a normal longitudinal striation are present at the beginning of the body-chamber.

Sutures.—The suture-line, of ceratitic development, shows rather narrow saddles with unbroken margin, with narrow lobes denticulated at the base. The external lobe is shorter than the first lateral one and divided by a small narrow median projection rounded above. The two halves of the lobes differ slightly from each other. This is caused by the circumstance that a few feeble denticulations which arise on the wall of the saddle from the two-pointed base occur on the right external saddle. The first lateral lobe is divided into from five to six points. The second lateral lobe possesses besides two distinct points also the trace of a third point on the side of the second lateral saddle.

Of the saddles the external one is the highest. The second lateral saddle is only weakly developed. It is situated on the umbilical wall, sinking down steeply to the suture.

Dimensions.—

Diameter	70	mm.
Height of the last whorl	25·5	"
Breadth " " "	20·5	"
Width of the umbilicus	27·5	"

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 1.

2. STEINMANNITES CLIONITOIDES, E. v. Mojs., Pl. XII., Fig. 6.

This species, unfortunately represented only by the figured fragment, gives a typical representation of an undulatostriate *Steinmannites* on the inner whorls, whilst the still chambered outer whorl tends to a resemblance with the *Clionites* type.

The outer volutions are somewhat higher than wide, but show a very slow increase in height. The penultimate whorl is still wider than it is high. The embracing is limited to the external part of the preceding whorl, which in the immature condition appears somewhat wider than in the mature state, when in consequence of the increase in height the external part shows itself to be a little more narrowly inflated. On the penultimate whorl the transverse section approaches a quadrate form with rounded angles, but on the last whorl it presents a rectangular form with preponderating height.

The sculpture consists on the inner whorls of two elements, independent of each other, *viz.*: (*a*) the transverse sculpture which continues on to the outer whorls, and (*b*) the oblique longitudinal striation which is confined to the inner whorls. As to the transverse sculpture, this agrees in general arrangement with that of the remaining species of the undulatostriate *Steinmannites*. The ribbing is moderately close. It becomes less close on the outer whorls, on which thus the width of the intercostal spaces increases. The ribs show a stronger concavity forwards on the sides of the inner whorls than on the outer whorls, on which up to the knob-like swellings, where commences the bend of the ribs, these (the ribs) turning obliquely forward on the external part, only show a slight curvature. The ribs are partly united in pairs to forked ribs, partly running undivided from the umbilical margin to the outer margin. On the outer whorl especially, the forked ribs show knot-like swellings on the umbilical margin. The single ribs show only faint indications of umbilical tubercles on the outer whorl. On the inner whorls, which are covered with oblique longitudinal striæ, distinct traces of lunulæ are to be seen, as in *Steinmannites undulatostriatus*. Secondary bifurcations of the ribs rarely occur on the knot-like swellings of the outer margin. To the rarity of such bifurcations and the wide separation of the ribs is to be attributed the great distance between the tubercles on the external keel of the outer whorl, as these tubercles are formed by the intersection of the ribs and the external keels. The closer notching of the external keels of the inner whorls is due to their closer ribbing. The obliquely running longitudinal striæ are divided within the circumference of the penultimate whorl into three parts, and the number of lunulæ within this circumference seems likewise only to be three, so that with each part only one lunula corresponds. It must further be remarked that besides the lunulæ no indications whatever of marginal tubercles on the inner whorls are present.

Sutures.—The external lobe almost reaches the depth of the first lateral lobe. It is divided into two halves by a small median projection, rounded above; and these are distinguished by three or four little points. The first lateral lobe shows four or five points, of which those lying nearest the saddles are shorter than the middle ones. The greater number is not observed in the foremost septa, which only possess four points, but further backwards. The second lateral lobe, which coincides with the umbilical margin, has two points, of which the inner is distinctly deeper than the outer, which inclines towards the first lateral saddle. The external and the lateral saddles are rather narrow, with an unbroken margin. There can scarcely be said to be a second lateral saddle, for the septum rises from the base of the second lateral lobe only to the height of the small denticulations dividing this lobe and then descends on the umbilical wall in a straight line vertical to the umbilical suture.

Dimensions.—

Diameter	45 mm.
Height of the last whorl	16·5 „
Thickness „ „ „	13·5 „
Width of the umbilicus	17·5 „

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 2.

3. STEINMANNITES DESIDERII, E. v. Mojs., Pl. XII., Fig. 7.

This species, closely related to *Steinmannites Clionitoides*, is distinguished from the latter by the permanence of the notched external keels. Thus, in

Steinmannites Clionitoides, the tubercles of the external keels occurring at wide intervals attain a certain independence, so that the keels on which they are placed become less conspicuous. In *Steinmannites Desiderii*, on the other hand, the tubercles on the external keels are but faintly developed, so that the latter become the more prominent.

A further distinction between the two species under consideration lies in the closer disposition and the slighter curvature of the ribs on the last whorl. Umbilical tubercles are very distinct here, whilst the indications of knot-like marginal swellings are but very slightly developed. This is probably dependent upon the fact that the ribs become obsolete at these marginal swellings and do not continue on to the external part, as is the case on the inner whorls which are provided with lunulæ and oblique longitudinal striæ.

The oblique longitudinal striæ form three divisions on the penultimate whorl. They are remarkably strongly developed and are present on the cast as well as on the shell. The anterior fragment of the last whorl is deficient in these striæ.

Sutures.—The suture-lines also show distinguishing features between the two species in question. Thus the first lateral lobe shows a considerable differentiation of the denticles, of which the small middle one is accompanied by two much higher ones, rounded above, whilst in *Steinmannites Clionitoides* such marked differences in size do not exist. The second lateral lobe is decidedly two-pointed; and the inner point which is already situated on the umbilical margin is also here the deeper one.

In contradistinction to *Steinmannites Clionitoides* there is a distinct second lateral saddle here which is situated on the umbilical wall.

Dimensions.—

Diameter	40 mm.
Height of the last whorl	17 ,,
Thickness ,, ,, ,,	14·5 ,,
Width of the umbilicus	13 ,,

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 3.

4. STEINMANNITES NOETLINGI, E. v. Mojs., Pl. XII., Figs. 8-9.

In spite of the difference in size between the specimens figured, the small one represented in Fig. 9 cannot be regarded as a young, immature form. It must be considered a mature individual, as it shows on the body-chamber, occupying the anterior half of the last whorl, the same variations of sculpture as the larger form represented in Fig. 8. But as some slight differences other than that of size can also be recognised, the smaller individual may be looked upon as a variety.

The inner whorls, provided with oblique spiral striæ and lunulæ, show a great similarity to *Steinmannites Clionitoides* and *Steinmannites Desiderii*. Essential differences are only to be observed after the obliteration of the oblique longitudinal striation on the body-chamber of mature individuals. The stronger curvature of the ribs on the sides, and especially their strong backwardly directed bend up to the marginal knot-like swellings together with the absence of the umbilical tubercles form a remarkable distinction. Furthermore the ribs on the sides are rather strong, and separated from one another by wide intercostal spaces.

But the external part of the body-chamber in a full-grown shell offers much more striking peculiarities (Fig. 8c). Between the marginal knot-like swellings and the notched external keels, but nearer the latter, for example, a spiral connection is formed between the neighbouring ribs where a forked division of the ribs not seldom results, as on the larger specimen (Fig. 8), whilst in the form Fig. 9, with a smaller body-chamber, such a division has never been observed. These divisions, which result in a corresponding increase of tubercles on the external keels, cease, however, also on the larger form towards the aperture.

A further feature of *Steinmannites Noetlingi* is exhibited, moreover, by the rather faint indications of normal longitudinal striæ observable on the body-chamber after the disappearance of the oblique longitudinal striæ.

The length of the body-chamber amounts to about three-quarters of the last whorl.

Sutures.—On the smaller form, Fig. 9, the denticulations extend from the base of the lobes to the walls of the saddle, whereby more numerous denticles arise. But it must be mentioned that the finer details of the lobes in the larger specimen (Fig. 8) could not be so distinctly observed as in the smaller one on account of less favourable preservation. In one place, however, in the larger form denticles arising from the first lateral lobe to the external saddle have also been observed. The external lobe is somewhat shorter than the first lateral one which is distinguished by great width. The saddles are only moderately high and arch-like in form. The umbilical suture coincides with the first auxiliary lobe.

Dimensions.—

Diameter	46 mm.
Height of the last whorl	17 „
Thickness „ „ „	16 „
Width of the umbilicus	17 „

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 3.

5. Steinmannites Lubbocki, E. v. Mojs., Pl. XIII., Figs. 2-3.

This species, which forms an independent type and does not agree with any species known up to the present time, is characterised by the extinction of the external keels in the anterior part of the body-chamber, connected with a slight depression of the tube.

The external habit of *Steinmannites Lubbocki* shows, it is true, some similarity to the forms of the group *Undulatostriati*. But it just wants the peculiar longitudinal sculpture which distinguishes this group; so that here only a remote relationship could be admitted.

On the inner whorls, as seen in Fig. 2, a rapid increase, especially in height, takes place, whilst on the last whorl, provided with the body-chamber, the increase in height is slow. This retardation of the growth in height increases in a very striking manner towards the end of the body-chamber, a circumstance which may be accounted for by the disappearance of the external keels and the simultaneous rounding of the external part. The whorls embrace one another only on the external part. But as the latter is rather strongly inflated and a rapid growth of the inner whorls in height takes place, the umbilicus remains proportionally narrow.

The sides are slightly inflated, but become flattened on the body-chamber. The external keels, as such, are only feebly developed. They rise with the broad and shallow external furrow, enclosed by them, over the inflation of the external part. The keels, as already mentioned, disappear entirely on the anterior part of the body-chamber, and the transverse ribs, greatly attenuated, close together over the rounded external part without forming external tubercles.

The ribs are very crowded on the innermost whorls and are here very fine. With the growth of the whorls the ribs, increasing considerably in strength, become wider apart so that broad intercostal spaces are formed. In the anterior part of the body-chamber, towards the aperture, the ribs get finer and are again more crowded. Bifurcations of the ribs occur seldom on the sides or outside the umbilical margin, which is distinctly marked only on the last whorl, but more frequently outside the marginal tubercles, which (the tubercles) are more distinctly developed on the inner whorls and gradually become obliterated on the last whorl. Indications of umbilical tubercles are present on the last whorl. Not all the ribs form tubercles on the external keels, as neighbouring ribs connect together here and there.

The keels are bordered by faint longitudinal depressions which take the place of keel-furrows.

As to the course of the ribs it has to be mentioned that up to the marginal tubercles the ribs are bent somewhat obliquely towards the posterior part. Outside the marginal tubercles the ribs bend in the opposite direction, that is, strongly forwards.

It is worthy of note that there are several fragments of body-chambers which, considering the rarity of the latter in the types related to this genus, leads one to infer that the shell was especially strongly constructed.

Sutures.—External lobe considerably shorter than the first lateral lobe, divided into three-pointed halves by a broad median projection with a rounded, unbroken margin. The first lateral lobe is seven-pointed and the second three-pointed with a longer middle point. The last suture-lines immediately preceding the body-chamber are somewhat less richly indented, as the first lateral lobe at this place only shows five points instead of seven.

Saddles with unbroken margin, rounded. External saddle rather narrow and high, first lateral saddle broader and lower. The second lateral saddle descends over the umbilical wall to the umbilical suture. In some places slight notches, succeeding the points of the lobes, are observed at the base of the saddles.

Dimensions.—

Diameter	64 mm.
Height of the last whorl	26 „
Thickness „ „ „	24 „
Width of the umbilicus	19 „

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 7.

e. DIONITES.

DIONITES, ind., cf. D. ASBOLUS (A. v. Dittmar).

We have here a form (unfortunately only a fragment of a whorl) which is comparable to *Dionites Asbolus* (Mojsisovics, Ceph. d. Hallst. Kalke, II. Bd., p. 492, Taf. CLIV., Figs. 8-9), or possibly even identical with this species. The broad, flatly rounded ribs with the strongly developed lines of growth are to be seen. They are crossed by indistinct spiral lines which cause a thickening at the point of intersection.

Sutures.—Not known.

Dimensions.—Not measurable.

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 1.

II. HERACLITEA.

1. HERACLITES, E. v. Mojs.

1879. Vorläufige kurze Uebersicht der Ammoniten-Gattungen der mediterranen und juvavischen Trias. Verhandl. der k. k. geolog. Reichsanst, p. 141.

1893. Cephalopoden der Hallstätter Kalke, Bd. II, p. 503.

The position assigned to the type described under the specific name of *H. jandianus* in the genus *Heraclites* requires some words of justification.

The length of the body-chamber in *H. jandianus* is somewhat more than half of the last whorl. As the sculpture in the foremost part of the last whorl is considerably weakened and reduced to striæ, and occurs as a rule only in the closest vicinity of the margin of the mouth in mature individuals, the present specimen is probably tolerably complete, and the length of the body-chamber might not have amounted to more than half a whorl.

The habit of the shell and its sculpture agree with those of *Ceratites*, whilst the lobes are indented in a dolichophyll manner. But shells with ceratitic development having lobes with dolichophyll differentiation are assigned to the genus *Heraclites*. The present shell cannot, however, be brought into closer connection either with the group of *Heraclites robusti*, or of *Heraclites suavi-*

costati, but represents an independent and unique type, to which the subgeneric name *Guembelites* might be applied.

Guembelites are shells with widely embracing whorls with a short body-chamber, having ceratitic sculpture on the sides, truncated, and completely smooth external part and small dolichophyll lobes which comprise also several auxiliary ones.

HERACLITES (GUEMBELITES) JANDIANUS, E. v. Mojs., Pl. X, Fig. 1.

The whorls are higher than they are wide and enclose a rather narrow umbilicus as they overlap one another very considerably. The sides are inflated and reach their greatest bulging in the vicinity of the sharply defined umbilical margin. The umbilical wall descends steeply to its suture. The external part is sharply marked off from the sides by the marginal "ears" which are elongated in the direction of the spiral. It forms a flattened smooth area, by which the sculpture on the two sides is completely interrupted.

The sculpture consists of fold-like ribs which are rather strongly developed on the inner whorls and at the beginning of the last whorl, but becomes visibly weaker on the anterior half of the last whorl. Bifurcations of the ribs, which show during their course a slight concavity towards the anterior part, take place partly near the umbilical margin and partly somewhat farther outwards, but always within half the height of the whorl. Instead of the bifurcations of the ribs there also occur intercalated ribs. After the appearance of these bifurcations or intercalations, two or three short ribs of the outer region of the sides correspond with one stem-rib in the umbilical region.

Near the outer margin, or rather near the marginal "ears", there occur on the body-chamber, besides the above-mentioned multiplication of the ribs, other peculiar offshoots of them into short narrow ribs, which enter into connection with the succeeding marginal "ears." In this way the marginal "ears" may be connected with two different ribs. But, on the other hand, one rib may also be united with two different marginal "ears." The number of the latter agrees with that of the short ribs proceeding from the primary divisions of the ribs, whilst the little ribs on the outer margin are merely offshoots. This feature has unfortunately not been fully brought out in our illustration.

Towards the end of the last whorl, the larger anterior half of which belongs to the body-chamber, the sculpture on the sides becomes weak, and flat striæ-like folds appear.

Sutures.—Unfortunately the details of the sutures could not be exposed as intact and complete as is necessary for an illustration. The dolichophyll saddles and lobes are short and thus rather narrow and numerous, as there are still two auxiliary lobes outside the umbilical margin. The external lobe seems to be shorter than the first lateral. Taking into consideration the denticulation the lobes of *Heraclites Bellonii*, Mojs. (Ceph. d. Hallst. Kalke, II. Bd., Taf. CXXXIX, Fig. 10c) may be brought into comparison.

Dimensions.—

Diameter	43 mm.
Height of the last whorl	22 ,,
Thickness ,, ,, ,,	19 ,,
Width of the umbilicus	5 ,,

Locality and Geological Position.—From the débris on the eastern slopes of the Jandi Pass, probably from the Halorites-Limestone. Number of specimens examined, 1.

2. Tibetites, E. v. Mojs.

1893. *Tibetites*, E. v. Mojs., Cephalopoden der Hallstätter Kalke, Bd. II., p. 516.

In this genus, replacing the European genus *Cyrtopleurites* in the Indian trias, three groups or subgenera may be distinguished, *viz.* :—

(1) *Tibetites*, s. str.
(2) *Anatibetites*.
(3) *Paratibetites*.

In the subgenus *Tibetites* the shape and sculpture of the body-chamber agrees entirely with those of the chambered parts of the shell. The morphological agreement with *Cyrtopleurites*, s. str., is extraordinarily great, and only the absence of the notchings on the external "ears", so characteristic of *Cyrtopleurites*, can be regarded as a distinguishing feature of the shell. Instead of the fringed[1] external "ears" of *Cyrtopleurites*, there occour in *Tibetites* therefore non-fringed external "ears." In the young, where the external part is still rather broad and flattened and the external "ears" are still weakly developed, the shells remind us of *Heraclites Ariciæ* and like this species show a complete ceratitic habit, which disappears with increasing age in consequence of the inflation and pointed shape of the external part, as well as of the considerable growth of the external "ears."

The subgenus *Anatibetites* is morphologically distinguished from the typical *Tibetites* by the flattening of the external part occurring on the body-chamber and by the simultaneous and entire obliteration of the external "ears." In consequence of this mode of variation, there exists morphologically such a close agreement with *Heraclites* that without the knowledge of the differently developed sutures *Anatibetites* could not be separated from *Heraclites*. The latter possesses dolichophyll sutures, whilst *Anatibetites* has the same ceratitic-developed sutures with divided external saddle as *Tibetites* and *Paratibetites*. After the obliteration of the external "ears" the body-chamber of *Anatibetites* offers the perfect representation of a *Ceratites* with the umbilical tubercles wanting.

The subgenus *Paratibetites* undergoes variations of quite a different character from those of *Anatibites*. While in the young the external part, as in *Tibetites* and *Anatibetites*, is still slightly inflated, it becomes in the middle stages of growth sharpened into proper keels accompanying the median furrow which has meanwhile appeared. Simultaneously with this the closing together of the external "ears" occurs. With this variation, which corresponds with the stage reached in the European species of *Hauerites*, the tendency towards a sharpening of the external part is, however, not yet exhausted in *Paratibetites*. With the simultaneous disappearance of the external furrow the two external keels close entirely together in the course of time, and the external part appears now obtusely pointed. In a manner analogous to that of *Hauerites* the lateral sculpture changes simultaneously with the sharpening of the external part and shows a tendency to become weaker and finally to disappear. The marginal and lateral tubercles fuse together to form spiral striæ, the ribs become flattened, and the disc assumes more and more a smooth-shelled character, till finally, as in *Paratibetites Tornquisti*, the marginal and lateral striæ also disappear and only obscure fold-like indications of the transverse ribs are observable.

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[1] Gewimpert.—Transl.

The sutures of *Tibetites*, *Anatibetites* and *Paratibetites* point, in a way similar to the morphological conditions of the young stage of growth, to the near relationship or rather to the common descent of a primitive form allied to the type of *Tibetites*. *Tibetites* and *Anatibetites* show, moreover, a suture-line with typical ceratitic development which is distinguished from the sutures of *Ceratites* only by the division of the external saddle, and by the freeing of an outer denticle of the saddle caused by this. The saddles have unbroken margins; the lobes are only slightly denticulated at their base. Certain variations are shown in *Paratibetites*. The most striking change is to be observed in the external lobe which shows a tripartite arrangement. The large median projection, namely, is indented lobe-like in the middle, and in some species the marginal "wings" arise in the shape of short external saddles. In these last-mentioned forms there occurs a denticulation of the middle region of the median projection bordered by the two marginal wings, whereby this part has the appearance of a shallow external lobe divided by quite a small median projection. Further peculiarities of the *Paratibetites* sutures are—(1) the independent character of the denticles, freed from the external saddle, and (2) the brachyphyll notching ascending the walls of the saddle, which sometimes reaches to the summit and here and there strengthens into dolichophyll denticulation (*Paratibetites angustosellatus*).

The sutures of *Paratibetites* agree with those of *Hauerites*. The strongly developed median projection with the saddle-like "wings" is common to both genera. The greater independence of the outer branch of the divided external saddle is also repeated in both genera. The only distinction is the degree of denticulation in the sutures. *Hauerites* is characterised by dolichophyll, and *Paratibetites* by ceratitic and brachyphyll development of the sutures.

In spite of this close relationship I do not consider it probable that *Hauerites* is directly descended from *Paratibetites*, as the tendency of *Paratibetites* is to form an obtusely pointed external part. *Hauerites* developes from forms which agree morphologically with *Cyrtopleurites*.[1] As well might it be assumed that *Cyrtopleurites* is the direct descendant of *Tibetites*, as *Cyrtopleurites* occurs already in the Julian beds, that is in about the same horizon in which *Tibetites* appears for the first time in India. Moreover the sutures of *Cyrtopleurites* differ from the sutures in *Tibetites* farther than the sutures of *Hauerites* differ from those of the genus *Paratibetites*. The external saddle of *Cyrtopleurites*, namely, possesses two freed outer branches and the external lobe of this genus shows itself to be divided in both its halves by a larger projecting denticle.

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[1] Cephalopoden der Hallstätter Kalke, Bd. II., p. 517.

We therefore regard the degree of relationship between the European and Indian genera in question as that of a very near collateral relationship, and see in these genera representative types developed in an independent way.

Tibetites occurs for the first time in the "Daonella beds," from which a specifically indeterminable form is present. In the *Halorites* beds the two subgenera *Anatibetites* and *Paratibetites* are to be added to *Tibetites*.

a. TIBETITES, s. str.

1. TIBETITES RYALLI, E.v. Mojs., Pl. XV, Figs. 3, 4.

This type shows a great morphological resemblance to the European species of *Cyrtopleurites*, as, for instance, the Julian *Cyrtopleurites Herodoti* (Ceph. der Hallst. Kalke, II Bd., p. 518, Taf. CLVIII, Fig. 10). The whorls, it is true, are higher than wide, but compared with related forms, only relatively wide; the external part is likewise rather wide and is somewhat inflated in the middle. The greatest width, however, is attained by the widely embracing whorls in the region of lateral tubercles, that is, somewhat below half of the height of the whorl. The umbilicus appears, compared with other forms, rather wide, in spite of the almost complete overlapping of the whorls.

As regards its shape there is no change in the body-chamber other than that caused chiefly by the growth of the shell. The character of the external part especially remains the same as on the chambered parts of the shell. The sculpture also on the body-chamber agrees in character with that of the chambered parts of the shell. The ribs on the sides, with only a slight sigmoidal curvature, are strongly developed and unite on the external part between the two external "ears" which arise out of them.

The ribs running in a straight direction from the deeply depressed umbilicus to the strong lateral tubercles undergo an increase outside the latter by bifurcation or intercalation, and all the ribs attain the same strength up to the outer margin, which is distinguished by strong, spirally elongated marginal tubercles. About two marginal tubercles correspond to one lateral tubercle. Only very seldom three of the former correspond to one lateral tubercle. A faintly developed spiral line connects the single lateral tubercles. The external "ears" are not "fringed,"[1] and seem to be strongly elongated in the direction of the spiral.

Tibetites Ryalli is distinguished from the similarly characterised *Paratibetites Bertrandi* by the much smaller dimensions which it reaches, but also chiefly by the persistence of the large external "ears" which remain the same on the inner whorls and on the body-chamber and undergo no changes. But these conditions could also be explained by assuming that the forms with small body-chambers are young individuals of *Paratibites Bertrandi.* This however is contradicted by the differing sculpture, not to mention the extraordinary rarity of young immature specimens. *Tibetites Ryalli* possesses a greater number of primary ribs and lateral tubercles corresponding to them. On the other hand, the number of intercalated ribs on the upper half of the sides is very small, so that, as already mentioned, two and only exceptionally three, marginal tubercles correspond, as a rule, to one lateral tubercle. It must be pointed out that the body-chamber on two specimens only could be observed, and that the third remaining one (Fig. 3, Pl. XV) shows only the beginning of the body-chamber.

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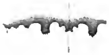
[1] Ungewimpert—Transl.

Sutures.—As regards sutures the present species approaches *Anatibetites Kelvini,* but the first lateral lobe is somewhat deeper and the outer lappet of the external saddle is only very faintly characterised, as only a very shallow-indented point produces an uneven division of the external saddle.



TIBETITES RYALLI.

Sutures from the specimen represented on Pl. XV, Fig. 3. Nat. size.

The second lateral lobe is two-pointed. The auxiliary lobes, two of which are outside the umbilical margin, only show extremely inconspicuous denticulations scarcely recognizable with the naked eye.

The external is the highest of the saddles. Beginning at the first lateral saddle the saddles appear to be wide and low, as in *Anatibetites Kelvini.*

Dimensions.—

Diameter	32	mm.
Height of the last whorl	16·5	„
Thickness „ „ „	13·5	„
Width of the umbilicus	5	„

Locality and Geological Position.—Juvavian Stage; in the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 3.

2. TIBETITES MURCHISONI, E. v. Mojs., Pl. XV., Fig. 5.

The proportionally narrow form only possesses slightly inflated sides and a body-chamber ornamentation which agrees with that of the chambered inner casts.

There are on the sides very narrow, fine stem-ribs, separated by broad intercostal spaces, which run in a straight direction up to the small but distinctly marked lateral tubercles and assume a more fold-like character with simultaneously-occurring sigmoidal curvature outside the lateral tubercles. An intercalated rib occurs, as a rule, between two stem-ribs; the secondary rib only seldom unites with the neighbouring stem-rib and then appears as a bifurcated rib. Only two marginal tubercles correspond generally to each lateral one. In the anterior part of the body-chamber strong lines of growth as well as single striæ-like ribs are observable. A fine faint spiral line connects the lateral tubercles.

As in *Tibetites Ryalli* and in many species of *Cyrtopleurites* the longitudinally elongated external "ears" which are situated on the closely-set ribs persist up to the anterior end of the body-chamber.

Sutures.—Not known in detail.

Dimensions.—

Diameter	36	mm.
Height of the last whorl	20	„
Thickness „ „ „	11·5	„
Width of the umbilicus	3·5	„

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 3.

3. Tibetites Perrin-Smithi, E. v. Mojs., Pl. XV, Fig. 6.

This species is closely related to *Tibetites Murchisoni* and is chiefly distinguished by numerous flat and crowded ribs which are grouped in a variable way.

In the circumference of the last whorl comprising the body-chamber in its anterior part, there are eight stem-ribs distinguished by lateral tubercles. These ribs are distinguished by greater strength from the weaker ribs, which alternate with them with tolerable regularity. These latter bear no lateral tubercles and seem to bear a scarcely perceptible swelling where the spiral line connecting the lateral tubercles together crosses them. As the ribs provided with lateral tubercles, as also the inserted weaker ones, bifurcate outside the lateral spiral line, the number of the marginal tubercles amounts to four times that of the lateral tubercles, but, on the other hand, only to double the number in *Tibetites Murchisoni*.

Towards the aperture of the body-chamber the sculpture becomes more striæ-like and indistinct. The longitudinally elongated external "ears" persist up to the anterior end of the body-chamber.

Sutures.—Not known in detail.

Dimensions.—

Diameter	42	mm.
Height of the last whorl	23	„
Breadth „ „ „ „	13	„
Width of the umbilicus	4	„

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 1.

4. Tibetites, f. ind.

This is a cast of a *Tibetites*, 22 mm. in diameter, from a sandy clay of the upper Daonella beds of the Bambanag Section; it bears the characteristic sculpture and possesses external "ears" besides the lateral and marginal tubercles.

A more minute description of the cast, which is comparable with *Tibetites Ryalli* but is more finely ribbed and therefore more richly ornamented, is precluded on account of its insufficient state of preservation. But it is nevertheless interesting to establish the fact that *Tibetites* appears already in the Carnic beds. The representative genus of *Tibetites* in Europe, *viz.*, *Cyrtopleurites*, appears nearly simultaneously in the Julian Limestone of Röthelstein, near Aussee.

b. ANATIBETITES.

1. Anatibetites Kelvini, E. v. Mojs., Pl. XIV, Fig. 9.

1880. *Balatonites Himalayanus* (Blanford) Griesbach, Records Geol. Survey of India, Vol. XIII, p. 98.
1891. *Balatonites Himalayanus* (Blanford) Griesbach, Mem. Geol. Survey of India, Vol. XXIII, p. 142.
1892. *Heraclites*, E. v. Mojs., Vorläufige Bemerkungen über die Cephalopoden-Faunen der Himalaya-Trias. Sitzungsber. d. kais. Akad. Mathem.-naturw. Cl., Bd. CI., Abth. I., p. 374.

The figured specimen, tolerably completely preserved, may be taken as the type of the species, while the one cited by Griesbach, to which alone all the above quotations refer, belongs to a variety distinguished by a somewhat more robust sculpture. Of this variety there is only a fragment of the body-chamber present.

The high-mouthed shell consists of widely embracing whorls which are higher than wide. The umbilicus is moderately wide where the whorls are chambered, but on the body-chamber it visibly narrows, a circumstance which is to be regarded as a consequence of the considerable increase in height.

The chambered whorls present exactly the appearance of an internal cast of a *Tibetites*. The moderately inflated external part, bordered by distinct marginal angles, bears upon these two rows of strongly marked external "ears," which appear to be situated at the extremities of the ribs reaching up to them. The sides are ornamented with slightly curved ribs increasing in width outwardly. The latter begin, without tubercles, on the umbilical margin and thicken considerably below the middle of the height of the sides, simultaneously forming strong lateral tubercles, after which they undergo a bifurcation. On the outer margin the ribs thicken into strong, spirally elongated, marginal tubercles.

Before the beginning of the body-chamber, on the last, still septate portion, there occurs a weakening or rather lowering of the external "ears," which gradually, through the growing together of their bases, are converted into notched thread-like longitudinal keels. A flattening of the external area on the body-chamber, on which the thread-like longitudinal keels soon disappear, takes place simultaneously with the modification of the external "ears." The figured specimen shows, on the anterior part of the body-chamber, a slight shallow depression in the middle of the external part. The lateral sculpture likewise undergoes some modifications on the body-chamber. Bifurcations of the ribs occur rarely, but the latter are more crowded together. The strength of the lateral and marginal tubercles also decreases considerably.

The great morphological agreement with *Heraclites* which the body-chamber offers is more strikingly evident in the above-mentioned variety from Rimkin Paiar. The fragment of the body-chamber distinguished by the somewhat more robust sculpture does not lose the external sculpture so quickly as the typical specimen given. Moreover the thread-like longitudinal keels continue, though with decreasing strength, farther on the body-chamber and still show knot-like elongated swellings at the point of intersection with the greatly weakened transverse ribs. More anteriorly there appears a faint fine middle line between the thread-like longitudinal keels in the middle of the external part. The agreement with some European *Heraclites*, as, for example, with *Heraclites Bellonii* (Ceph. der Hallst. Kalke, II. Bd., p. 507, Taf. CXXXIX., Fig. 10) and *Heraclites robustus* (l. c. p. 505, Taf. CXL., Figs. 9, 10) is, through the peculiarities here described, so great that without a knowledge of the sutures there would not be the least hesitation about placing the Indian form in *Heraclites*, as I have done with the fragment of the body-chamber from Rimkin Paiar.

Sutures.—The sutures also point to the close genetic relationship with *Tibetites*, in which genus exactly the same ceratitic type of sutures, a type characterized by a division of the external saddle, is repeated. The present species is distinguished by remarkably shallow lobes, finely and regularly denticulated at the base, and low broad saddles. The denticle, separated from the external saddle by an indentation, is proportionally small and narrow. The external lobe is lower than the first lateral lobe, divided by a trapeze-like median projection. Indications of two slight projections are noticeable in both the halves of the lobes. First lateral lobe broad, with about six or seven slight serrations at its base. The second lateral lobe and the succeeding three auxiliary lobes up to the umbilical margin show a very slight gradually decreasing serration.

The broad low saddles are like right angles in which the angles have become blunt and rounded. The external saddle is somewhat lower than the first lateral saddle. It must be mentioned that the character of the sutures, of course putting aside the denticle freed from the external saddle, reminds us greatly of the type of sutures of the *Ceratites* of the German Muschelkalk.

Dimensions.—

Diameter	54 mm.
Height of the last whorl	31 "
Thickness " " "	20 "
Width of the umbilicus	3 "

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 3; from Rimkin Paiar, 1.

2. ANATIBETITES, nov. f. ind.

The fragment of a body-chamber, which is broken off at the last septum, reminds us through its similarly robust sculpture as well as by its shape, of the large variety of *Heraclites robustus* (Ceph. der Hallst. Kalke, II Bd., p. 505, Taf. CXXXVIII), but is considerably narrower and must have also possessed a much narrower umbilicus.

The flattened external part shows a median longitudinal line on the cast.

Locality and Geological Position.—In the Halorites-Limestone of the Bambanag Section.

c. PARATIBETITES.

1. PARATIBETITES BERTRANDI, E. v. Mojs., Pl. XV, Fig. 1.

This shell, distinguished by a very strong sculpture, consists of widely embracing whorls which are higher than wide and enclose a narrow umbilicus. The external part is slightly inflated at the beginning of the last, still chambered whorl, but rises crest-like with the middle part bordered by the external "ears" towards the end of this whorl. The sides are inflated and reach the maximum of inflation at the strong lateral tubercles.

The sculpture consists in the lower part of the sides of undivided chief ribs running in a straight direction to the lateral tubercles. There are on the whole only nine of these ribs, in the circumference of the last whorl. These chief ribs are divided outside the lateral tubercles regularly into two ribs which do not again bifurcate. They run up to the external part with a slight concavity directed forwards and bear spirally elongated marginal tubercles on the outer margin and narrow elongated external "ears" on the external part. These latter border the middle region of the external part on both sides, this region being traversed by transverse ribs. Besides the above-mentioned chief ribs, characterized by lateral tubercles, there are also intercalated ribs present which may in some places be traced to a distance below the spiral formed by the lateral tubercles, but they mostly disappear outside this spiral. In the interspace formed by two succeeding pairs of bifurcating ribs proceeding from the lateral tubercles there is, as a rule, only one intercalated rib present. Two intercalated ribs are, however, sometimes observed. Three marginal tubercles correspond therefore to one lateral tubercle, and only in rare cases four marginal tubercles to one lateral tubercle. The intercalated ribs have already attained the strength of the bifurcated ribs on the outer margin, and they are likewise provided with marginal tubercles and external "ears."

The height of the external "ears" in the anterior part of the last whorl (chambered throughout) decreases in the same degree as the middle of the external part begins to rise like a crest. The external part now rises steeply roof-like towards the narrow flattened crest, which is bordered by the external "ears" (only slightly indicated) nearly fusing with one another.

It is to be presumed that in consequence of the continuous heightening and narrowing, the external part might on the body-chamber have been perfectly pointed, somewhat as in *Paralibetites Adolphi* and *Paratibetites Tornquisti.*

Sutures.—The median projection, having an unbroken margin, is divided in the middle by a deep indentation into two lappets. The lappets thus formed are rounded above. The two halves of the external lobe are one-pointed; they do not reach the depth of the first lateral lobe which seems to be divided at its base into two points by a larger projecting denticle. The second lateral lobe possesses two larger denticles, the first auxiliary lobe again only one, distinguished by greater dimensions. Up to the umbilical margin four denticulated auxiliary lobes may be counted.

An outer lappet is freed from the external saddle by a deep indentation, so that the external saddle appears bipartite. The outer lappet is narrower and somewhat lower than the inner part—the chief part—of the external saddle. In the deep part into which the dividing point descends there is a small denticle to be seen on the outer side of the outer lappet. The outer wall of the saddle of the chief part also shows faint traces of serrations. Three small denticles arise from the first lateral lobe on the walls of the two neighbouring saddles. In the second lateral lobe there are only two such small denticles at the base of the saddles. All the saddles are rounded above with an unbroken margin. The greatest height is reached by the narrow first lateral saddle.

Dimensions.—

Diameter	59 mm.
Height of the last whorl	34 „
Breadth „ „ „	23 „
Width of the umbilicus	5·5 „

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 2.

2. Paratibetites Geikiei, E. v. Mojs., Pl. XV, Fig. 2.

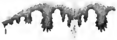
This type which might be taken for a more closely-ribbed variety of *Paratibetites Bertrandi* is distinguished by a series of modifications in the sculpture and sutures whereby the validity of the species seems to be sufficiently established.

The finer and closer lateral sculpture may be mentioned first. In the circumference of the last chambered whorl there are fourteen lateral tubercles, to which double the number of marginal tubercles correspond, for here, in contrast to *Paratibetites Bertrandi,* only two bifurcated ribs reaching the outer margin fall to one chief rib. These bifurcated ribs, which may also assume the character of intercalated ribs, curve between the lateral and marginal tubercles with a concavity directed forwards and bend on the external part obliquely towards the anterior. On the inner whorls and at the beginning of the last whorl preserved, which belongs entirely to the body-chamber, there are distinctly characterized longitudinally elongated external "ears" situated upon the ribs. But the "ears" are very soon changed on this last whorl into true external keels by fusion. They enclose a middle furrow. Undulations of the keels now take the place of the external "ears;" but not every rib corresponds to one of the undulations, the number of which is somewhat less than that of the ribs.

More anteriorly the external furrow seems to flatten and to assume a shape similar to that of *Paratibetites Bertrandi*, but the defective preservation in this region does not admit of a sufficiently reliable observation.

The stage of growth in which there is a middle furrow accompanied by external keels, is not present in *Tibetites Bertrandi*.

Sutures.—The sutures also present differences compared to *Paratibetites Bertrandi*.



Paratibetites Geikiei.

Sutures from the specimen figured on Pl. XV, Fig. 2. Nat. size.

The small size of the outer lappet freed from the external saddle may first be mentioned. This is so small and low that it could be considered as a large denticle dividing the two halves of the external lobe, the more so as the point which separates it from the external saddle shows an indication of a serration such as occurs in lobes produced by a small "tooth" projecting in the middle.

Further distinctions are presented by the brachyphyll notchings which reach the summit of the first two chief saddles on the walls turned towards the first lateral lobe.

Dimensions.—

Diameter	49 mm.
Height of the last whorl	26·5 „
Thickness „ „ „	18 „
Width of the umbilicus	5 „

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 5.

8. Paratibetites Adolphi, E. v. Mojs., Pl. XV, Figs. 7-10.

The large specimen of a body-chamber illustrated in Fig. 7 is to be regarded as the type of the species, to which the chambered form, Fig. 8, also belongs. The Figures 9 and 10 represent variations.

This species is not only subject to a not inconsiderable individual variability but also to rather strong ontogenetic modifications occurring in the course of the last whorls. The innermost whorls agree in respect of their sculpture and shape completely with a typical *Tibetites* provided with external "ears." From this stage of development *Paratibetites Adolphi* passes into the stage characterized by an external furrow with accompanying undulated keels. The external part assumes the shape of a slightly truncated blade with increasing sharpness and narrowing; this being accompanied by a gradual weakening of the lateral sculpture. The external keels have become completely obliterated, and the marginal tubercles, on the other hand, converted into a continuously running spiral line. The ribs on the sides are greatly weakened and have become falciform folds ending at the marginal striæ. The lateral tubercles persist, more or less weakened, to the mouth of the body-chamber. The folds on the body-chamber are most strongly developed outside the lateral tubercles.

The increase of the ribs results from bifurcation or intercalation outside the lateral tubercles. It is indicated by the proportion of the marginal tubercles to the lateral ones, two to three marginal tubercles going to one lateral tubercle. Indications of feeble fine folds occur on the body-chamber in the wide interspaces between two stronger folds. The lateral tubercles are also connected by a faintly indicated spiral line.

The variety illustrated in Fig. 9 is distinguished by closer ribbing and modifications in the course of the suture-line. The specimen, Fig. 10, represents a small variety which has already attained the features of maturity while still of small dimensions.

Sutures.—The suture-line stands in a transition stage from the ceratitic to the brachyphyll development and therefore approaches the type of sutures of *Hauerites*. In some elements of the sutures, especially on the inner wall of the external saddle and on the walls of the median elevation, the denticulation has ascended from the base of the lobes to the summit of the saddle. The median projection is of very considerable height and is divided in the middle by an indentation into two lappets. The two halves of the external lobe are, as a rule, three-pointed, with a longer middle point. The first lateral lobe, which is at the same time the deepest, is distinguished by great breadth; it is rather regularly denticulated at its base, whilst the denticles ascending on the walls of the saddles are considerably smaller. The number of auxiliary lobes situated outside the umbilical margin amounts to three. Of the saddles, the lateral one is distinguished by its characteristic shape. In *Paratibetites Adolphi*, for example, the outer lappet is as wide as, or even somewhat wider than, the true external saddle, so that the latter appears as a double saddle divided by a deeply cut indentation. In the variety illustrated in Fig. 9 this indentation almost assumes the character of an adventitious lobe on account of its greater width.

The variety just mentioned is also distinguished by more extensive denticulation of the saddles and by the greater breadth of the latter, as well as by the two-pointed division of the first auxiliary lobe, which shows a remarkably large median denticle.

Dimensions.—

Diameter	60 mm.
Height of the last whorl	35 „
Thickness „ „ „	17·5 „
Width of the umbilicus	4 „

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 10.

4. Paratibetites angustosellatus, E. v. Mojs., Pl. XVI, Figs. 1-4.

Of this species there are only chambered specimens in which, on the anterior fractured edge, the external furrow sunk between feeble longitudinal keels is still present. But as this furrow, as could be proved from several specimens, visibly weakens in the direction of the body-chamber, it is to be supposed that, as in the closely related *Paratibetites Adolphi*, the furrow becomes entirely obliterated on the body-chamber and the external part assumes the form of a truncated blade.

In the typical forms, Figs. 1-2, the reduction of the lateral sculpture to the dimensions of weak folds and the obliteration of the three series of spiral tubercles occur already very early. The disappearance of the lateral tubercles and their replacement by a spiral line form an essential distinction in contrast to *Paratibetites Adolphi*. The early conversion of the marginal tubercles into a marginal spiral ridge, which in the present species occurs already on the chambered whorls but in *Paratibetites Adolphi* only on the body-chamber, is likewise very remarkable.

I consider the fragment illustrated in Fig. 3 as a variety characterized by a more robust sculpture and a later beginning of the latter. In this form also the lateral tubercles decrease remarkably in size in the vicinity of the anterior margin.

Sutures.—The suture-line offers a very good basis for the characterization of the present species; the external saddle and the median projection of the external lobe especially exhibit the peculiarities.

By the fact that from the wide depression in the middle of the large median projection another small elevation arises which entirely resembles a low small median projection, the lateral lappets almost acquire the appearance of independent external saddles, somewhat comparable to the external saddles of the groups of the genus *Ptychites*, which are provided with a short external lobe.

The outer lappet, separated from the external saddle, is, in striking contrast to that of *Paratibetites Adolphi*, so extraordinarily slender and low that it does not give the impression so much of an independent saddle as of an accessory denticle of the external saddle.

The serration of the suture-line progresses still further than in *Paratibetites Adolphi*. It almost assumes the character of a dolichophyll serration on the inner wall of the external saddle (Fig. 4).

There are three auxiliary lobes outside the umbilical margin.

Dimensions.—

Diameter	51 mm.
Height of the last whorl	31 „
Thickness „ „ „	12 „
Width of the umbilicus	3 „

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 8.

5. Paratibetites Tornquisti, E. v. Mojs., Pl. XVI, Fig. 5.

The inner whorls of this species may be considered to agree almost entirely with those of *Paratibetites angustosellatus*, and I should perhaps have had no hesitation in regarding the present specimens of the species just named as the young stages of growth of *Paratibetites Tornquisti*, if the different structure of the sutures had not made the separation necessary.

The specimen figured shows a disc chambered throughout and culminating in a blunt blade externally. This disc gives the impression of an Ammonite of the division of the *Leiostraca* by its high-mouthed almost smooth shell. The external part is already bluntly pointed at the beginning of the last whorl. The position of the marginal tubercles is still marked by a marginal spiral ridge, but this spiral is entirely obliterated in the further course of the last whorl. Lateral tubercles are not present, or are only indicated. The lateral sculpture is confined to feeble indications of sigmoidal folds which terminate on the marginal spiral ridge. The small remnants of the shell which have been preserved from the region of the umbilicus of one half show strong lines of growth.

Sutures.—This specimen, which shows the duplication of the suture-line in an excellent way, only possesses rounded summits of the saddles with unbroken margin in spite of its considerable size.

The strongly developed median projection, the outer lappets of which ascend nearly to the height of the outer half of the external saddle shows, in the middle depressed region, three denticles separated by shallow indentations, of which the central one again takes the position of a median projection.

The external saddle is divided into two unequal halves, the inner one of which is wider and higher than the outer one. Both halves are denticulated in the brachyphyll manner on the walls turned towards the deeply cut indentation. The two halves of the external lobe, as well as the indentation dividing the external addle, run together into one point at their base.

The first lateral lobe is four-pointed at the base. Other denticles ascend the walls of the saddles but without reaching their summits. The second lateral lobe and the auxiliary lobes, four of which occur outside of the umbilical margin, are wide and beset with many teeth of approximately equal size at their base. The auxiliary saddles are broad and low.

Dimensions.—

Diameter	130 mm.
Height of the last whorl	76 ,,
Thickness ,, ,, ,,	33 ,,
Width of the umbilicus	5 ,,

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 1.

3. HAUERITES, E. v. Mojs., Vergl. Cephalopoden der Hallstätter Kalke, Bd. II, p. 527.

HAUERITES (?) nov. f. ind., Pl. XVI, Fig. 6.

The sutures illustrated are taken from a fragment of a chambered whorl with a bluntly-pointed external part. Supposing the fragment to be complete, one should obtain a disc similar to that of *Paratibetites Tornquisti*, distinguished, however, by a somewhat greater breadth of the whorls. Whether it is correct to assign it to the genus *Hauerites*, as yet recognised with certainty only in Europe, must remain doubtful, specially as the tapering of the external part to a blunt blade without a furrow has not yet been observed in *Hauerites*.

The character of the suture-line does not, on the other hand, admit of any doubt that we have to deal with a species only distinguished from *Paratibetites* by the dolichophyll development of the sutures. *Paratibetites* agrees, apart from the tapering of the external part occurring on the outer whorls, with *Hauerites* in the most essential features and differs only in the gradual development of the sutures which is ceratitic-brachyphyll, whilst *Hauerites* has already reached the dolichophyll stage. As it does not, from the analogy of *Paratibetites*, seem impossible that a bluntly tapering external part might by a fusion of the two external keels have arisen in *Hauerites* as well as in a subgenus closely related to it, we have placed the present fragment for the time being in *Hauerites*, emphasizing however the uncertainty existing in the case.

Sutures.—The closest agreement with *Paratibetites* exists, as already mentioned, in the arrangement of the sutural elements, and especially *Paratibetites angustosellatus* shows the entirely identical arrangement of the median projection which is indented in the middle like a lobe and flanked by large saddle-like lappets.

In the lobe-like indentation of the median projection there arises a very broad central body, again comparable to a median projection, and provided with five little summits bluntly rounded above and with four rounded points between them. The central body is separated from the saddle-like lappets on both sides by a deeper indentation. The resemblance of these high lappets, provided with notches, to the external saddles of *Ptychites* is very striking. The outer branch of the saddle, freed from the true external saddle, is characterized by the lobe-like form of the indentation separating them in the manner of an adventitious saddle.

The main stem of the external saddle is divided by the freeing of a larger upper lateral branch, whereby the culminating stem becomes very narrow. The notches are throughout dolichophyll. The two lateral saddles have suffered through weathering and they appear for this reason simpler in our illustration than would be the case in uninjured specimens. The auxiliary lobes are not preserved. As to the chief lobes, the two halves of the external lobe appear two-pointed through a small elevated denticle, whilst the first lateral lobe fuses into one deep point.

Dimensions.—Not measurable.

Locality and Geological Position.—Juvavian Stage; in black limestone of the group of beds, No. 6, of the Bambanag Section. Number of specimens examined, 1.

b. TIROLITIDÆ.

1. TRACHYCERATEA.

The family of the Tirolitidæ is represented in the Indian trias only by trachyceratea which, however, do not play any important part and appear like elements of a foreign fauna within the Ceratitoidea, well represented by the Dinaritidæ.

1. TRACHYCERAS, LAUBE.[1]

a. PROTRACHYCERAS.

GROUP OF PROTRACHYCERATA VALIDA.

PROTRACHYCERAS RALPHUANUM, E. v. Mojs., Pl. XVII, Fig. 6.

This fragment, chambered throughout, belongs to a narrow rather high-mouthed form from the group of *Protrochycerata valida*, in which it reminds us by the character of its sculpture mostly of *Protrachyceras Aeoli* from the Julian Hallstatt Limestone (Ceph. der Hallst. Kalke, II Bd., p. 639, Taf. CLXXI, Fig. 1). Also *Protrachyceras longobardicum*, from the Longobardian Stage (Ceph. der medit. Trias-provinz, p. 126, Taf. XVIII, Figs. 4, 5; Taf. XX, Fig. 1; Taf. XXII, Fig. 5) shows a considerable resemblance in its shape and in the corresponding number of spiral tubercles. There is nevertheless no complete agreement with any of these forms, so that we may well consider the present form as a new species.

In striking contrast to the feebly developed broad ribs separated by wide intercostal furrows stands the strong development of the spiral tubercles, of which there are altogether eight rows. The strength of the tubercles in *Protrachyceras Aeoli* also surpasses that of the feebly developed widely separated ribs, and the one essential distinction which exists is that the interspace between the oblique spirally-elongated external "ears" and the marginal tubercles in *Protrachyceras ralphuanum* is much less than that in *Protrachyceras Aeoli*. The ribs of *Protrachyceras ralphuanum* also show a somewhat stronger bending on the sides.

Sutures.—Not known in detail.

Dimensions.—Not measurable.

Locality and Geological Position.—Carnic Stage; in blackish-grey limestone from the rocky cliffs facing the Ralphu Glacier, on the left bank of the Lissar River. Number of specimens examined, 1.

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[1] Cephalopoden der Hallstätter Kalke, Bd. II, p. 617.

b. TRACHYCERAS, s. str.

TRACHYCERAS, n. f. ind., Pl. XI, Fig. 9.

This undeterminable fragment, probably representing a new species, was only figured in order to show that, contrary to the Tuvalic Tropites beds of the Mediterranean Province, and in harmony with the reports of Perrin Smith on the Tropites Limestone of California, representatives of the genus *Trachyceras* are present in the Tropites Limestone of the Himálaya.

Though the external part could not be exposed it seems, from the experience gained in the study of European material, scarcely doubtful that we have to deal here with a *Trachyceras*. The lateral sculpture shows the characteristic habit of the true Trachycerata. The great number of spiral tubercles, the kind of development of the feebler series of tubercles, that is, appearing on the ribs and spirally weakening anteriorly, the character of the umbilical tubercles, the nature of the curvature and division of the strong ribs, which are separated by deep intercostal furrows, are all in complete harmony with such a supposition. One might even be tempted to express the opinion that the present fragment might belong to a species from the group of *Trachycerata margaritosa*. A decided opinion cannot, however, be given at present.

The slight width of the umbilicus or the considerable involution would be in accordance with the knowledge of the fact that the geologically younger members of a stock or a series of forms are very frequently much more involute than those which are geologically older. For on the supposition that the Tropites Limestone of the Himálaya as well as the Alpine Tropites Limestone are of Tuvalic age, the species represented by the present fragment would belong to the geologically youngest representative of its kind.

Sutures.—Not known.

Dimensions.—Not measurable.

Locality and Geological Position.—Carnic Stage; in the Tropites Limestone of Kalapani, in the Valley of the Kali River. Number of specimens examined, 1.

GROUP OF TRACHYCERATA DUPLICA.

TRACHYCERAS TIBETICUM, E. v. Mojs., Pl. XVII, Fig. 7.

Cf. *Trachyceras Austriacum*, E. v. Mojs., Cephalopoden der Hallstätter Kalke, Bd. II, p. 677, Taf. CLXXXII, Fig. 8; Taf. CLXXXIII, Figs. 3, 5-9; Taf. CLXXXIV, Figs. 1-3; Taf. CLXXXV, Fig. 1.

The specimen illustrated, *viz.*, a cast with the beginning of the body-chamber, agrees in its general features with *Trachyceras Austriacum* from the Feuerkogel near Aussee in such a remarkable way that I should not have hesitated to identify it with this characteristic species[1] but for the fact that the more simple structure of the suture-line required the isolation of the Indian form. I therefore regard this latter as the representative of *Trachyceras austriacum* and designate it *Trachyceras tibeticum*. Should the differentiation of the species not be considered justified —which in this, as in so many other cases, is only a matter of individual conception or personal judgment—the varietal name, *var. tibetica*, should be added to the Indian form of *Trachyceras austriacum*.

In contrast to the illustrations of the shells of *Trachyceras austriacum*, our illustration of *Trachyceras tibeticum* shows this difference that, instead of the external double row of tubercles occurring in *Trachyceras austriacum*, only knot-like extremities of the ribs are to be seen in *Trachyceras tibeticum*. This is owing to the fact that the present specimen of *Trachyceras tibeticum* is a cast on which knot-like projections of the extremities of the ribs are shown, instead of the external spiral rows of tubercles, as mentioned in the above-cited description of the species, *viz.*, *Trachyceras austriacum*. A specially strong development of the projections of the extremities of the ribs is, however, reached in the Indian cast. The swellings of the extremities of the ribs are separated from the laterally situated spiral tubercles by spiral depressions. Taking the rows of the external tubercles in the shells as two in number, the total number of the spiral tubercles occurring in one half of a whorl amounts to 15.

Sutures.—Compared with *Trachyceras austriacum* the saddles show a less deep denticulation of their stems. The first lateral lobe fuses into a narrow point, whilst in *Trachyceras austriacum* this lobe is wider and appears tripartite.

Dimensions.—

Diameter	49	mm.
Height of the last whorl	23	„
Thickness „ „ „ „	20·5	„
Width of the umbilicus	12	„

Locality and Geological Position.—Carnic Stage; in the Crinoidal Limestone of Rimkin Paiar. Number of specimens examined, 1.

2. SANDLINGITES, E. v. Mojs., Cf. Cephalopoden der Hallstätter Kalke, Bd. II. p. 706.

1. SANDLINGITES NICOLAI, E. v. Mojs., Pl. XVII, Figs. 1, 2.

The slowly increasing whorls are almost as high as wide and embrace one another only on the widely inflated external part, up to the marginal tubercles, which are thus visible in the widely opened umbilicus to the spiral of involution.

The sculpture consists of sharp-edged narrow transverse ribs separated by wide intercostal furrows and mostly running undivided over the sides to the external part, where they terminate on the inner whorls with feeble spine-like tubercles before they reach the smooth median band, while on the body-chamber they close gradually more distinctly together from both sides, whereby the external tubercles decrease in strength at the same time.

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[1] In the preliminary list of fossils supplied to Dr. Diener for his geological memoir this form was quoted as *Trachyceras* cf. *Austriacum*.

The ribs are somewhat more strongly developed in the lower part of the sides and run here in a strictly radial direction up to the angular elevation, from which point the ribs becoming somewhat weaker describe a slight concavity directed anteriorly up to the marginal tubercles. From the marginal tubercles the ribs run tolerably straight up to the external tubercles. If one observes the surface of the ribs on the cast closely, their edge appears as if formed of sharp apertural margins which, in some places near the umbilical margin on the above-mentioned stronger parts of the ribs, show crescents whose concavity is directed forwards. The bifurcation or intercalation of the secondary ribs which has been asserted not to occur often, takes place outside the above-mentioned angular elevation of the stem ribs. Where the shell is preserved the surface of the ribs appears less sharp-edged and even slighter.

In the illustration (Fig. 2) of the external part the bifurcations of the ribs occur somewhat more frequently.

Sutures.—The suture-line shows a close agreement with that of *Sandlingites Archibaldi*; it ascends in a similar way to the extremely shallow second lateral lobe and has an unbroken margin, with the exception of the two points of the external lobe and the feebly indicated serration of the first lateral lobe. The external saddle is considerably lower than the lateral one. The second lateral lobe is on the umbilical margin.

Dimensions.—

Diameter	28	mm.
Height of the last whorl	6·5	„
Thickness „ „ „	6	„
Width of the umbilicus	14	„

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 3.

2. Sandlingites Archibaldi, E. v. Mojs., Pl. XVII, Figs. 3—5.

This species which is easily distinguished from *Sandlingites Nicolai* by its numerous crowded transverse ribs, lacks the stronger accentuation of the stem ribs, the angular elevations on them before the beginning of the bifurcation of the ribs and their backward curvature. Where the shell is preserved (*e.g.*, inner whorls of Fig. 4) the ribs, slightly bent on the sides, are somewhat rounded; where the shell is wanting the ribs appear more sharply edged, as in Figs. 3 and 5, and separated by wider intercostal furrows. Bifurcations of the ribs are not infrequent and occur at varying heights, mostly on the sides, but sometimes also near the umbilical margin. The marginal and external tubercles are sharply marked on the chambered parts of the shell.

The sculpture is interrupted on the inner whorls in the middle of the external part but closes here in most specimens on the chambered parts, in which case, however, the external tubercles become fainter or disappear entirely. The sculpture assumes an irregular and somewhat obscure character on the body-chamber and the marginal tubercles become obliterated. The present species shows some resemblance to the European *Sandlingites Reyeri* (Ceph. der Hallst. Kalke, II. Bd., p. 713, Taf. CLXVII., Fig. 3), from which it is distinguished by the lower whorls and the feebler curvature of the ribs on the sides.

Sutures.—The external lobe is divided into two points by a small bluntly-pointed median projection and is deeper than the first lateral lobe. The latter is slightly serrated, whilst the strikingly low second lateral lobe, succeeding the high lateral saddle, is not serrated. The internal lobe is of moderate depth and width and appears at its base rounded and not serrated. The saddles have an unbroken margin. The external saddle must be considered low in comparison with the lateral saddle, ascending high from the first lateral lobe.

Dimensions.—

Diameter	40 mm.
Height of the last whorl	10 „
Thickness „ „ „	8·8 „
Width of the umbilicus	21·5 „

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 11.

3. SIRENITES, E. v. Mojs., Cf. Cephalopoden der Hallstätter Kalke, Bd. II., p. 725.

GROUP OF SIRENITES ARGONAUTÆ.

1. SIRENITES ELEGANS, E. v. Mojs., Pl. XVII, Figs. 8, 9.

This narrow high-mouthed shell is narrowly umbilicated and shows a rapid growth in height. The sides are feebly inflated and converge towards the narrow external part which is formed by the two keels enclosing a deep external furrow. Towards the narrow umbilicus the shell slopes gently (without any intervening sharply marked umbilical margin characterized by stronger tubercles) towards the umbilical suture.

The transverse sculpture on the penultimate whorl of the fragment illustrated in Fig. 9 predominates, in reference to its strength, over the longitudinal sculpture represented by the series of tubercles, and the sigmoidally curved ribs become weaker only below the middle of the sides where two to three rows of spirally elongated tubercles are more conspicuous. This lateral sculpture reminds us forcibly of that of *Protrachyceras Hadwigæ* (Ceph. der Hallst. Kalke, II. Bd., p. 624, Taf. CLXVI, Figs. 4, 5) and of *Anasirenites Ekkehardi* (Ceph. der Hallst. Kalke, II. Bd., p. 773, Taf. CLIX, Figs. 5, 6). True external keels are not present in the posterior half of the penultimate whorl, the only part available for examination. The ribs terminate with obliquely placed external tubercles, and irregularly alternating bifurcations, characteristic of *Sirenites*, occur immediately before the external tubercles, so that two tubercles correspond to one rib. Between these there are ribs with only one external tubercle. Many *Sirenites* show this feature either in the more youthful stage of growth, or also in the adult condition. We have observed forms of the last category as transition forms between the *Protrachyceras*-stage and the stage of *Sirenites*.

On the outer chambered whorls illustrated in Figs. 8 and 9, crenulated external keels have taken the place of the external tubercles and the transverse ribbing of the lateral sculpture becomes less prominent compared with the longitudinally arranged series of tubercles, of which from 10 to 13 may be counted. The ribs have on the sides a strong concavity towards the anterior succeeded by a not inconsiderable backward curvature on the outer part of the sides. The last part of the ribs, again curving forward, becomes more conspicuous and individually stronger or weaker according to the strength of the development. The tubercles show a less rounded outline. There are two tubercles on the above-mentioned more strongly-marked portions of the ribs. The single series of the tubercles are of unequal strength and succeed one another at unequal distances. *Sirenites elegans* shows a great resemblance to *Sirenites Stachei* (Ceph. der Hallst. Kalke, II. Bd., p. 770, Taf. CLVII, Fig. 8), from which it is, however, distinguished by the different arrangement of the more strongly marked portions of the ribs, as well as by the modifications in the sutures.

Sutures.—The external lobe is shallower than the first lateral lobe and is divided in each of its halves into two points by a narrow denticle. The two lateral lobes, the first of which reaches the greatest depth of any of the lobes, end in one point. About four small auxiliary lobes succeed these and reach the umbilical margin. The external saddle is distinguished by strong development and considerable height. It is divided into two halves by a deeply penetrating secondary lobe, of which the outer half, nearest to the external lobe, is the narrower and lower one. The denticulation has reached the leptophyll stage.

In striking disproportion to the height of the external saddle is the insignificant elevation of the first lateral saddle and of the other saddles following in regular gradation of size. The auxiliary lobes appear as narrow denticles.

Dimensions.—These are not measurable on account of the fragmentary state of the specimens.

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 2.

2. SIRENITES RICHTERI, E. v. Mojs., Pl. XVII, Fig. 10.

This species is very closely related to *Sirenites Evæ* from the Lacic Limestone of the Leislingwand (Ceph. der Hallst. Kalke, II. Bd, p. 769, Taf. CLVI, Figs. 8, 9) and is distinguished only by the greater number of spiral tubercles and the stronger development of the sculpture. While *Sirenites Evæ* possesses rather crowded transverse ribs and, apart from the crenulated external keels, only seven spiral rows of tubercles, *Sirenites Richteri* is distinguished by more distant and less numerous transverse ribs and the presence of ten spiral rows of tubercles. These rows of tubercles are of unequal strength and succeed one another at irregular distances. The marginally placed row of tubercles shows an elongation in the direction of the ribs, whereas in the other tubercles the tendency to a spiral elongation is more or less visible. The weaker intercalated rows of tubercles especially show this elongation. The ribs are only slightly curved and may bifurcate at varying heights.

Sutures.—Not known in detail.

Dimensions.—Not measurable.

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 1.

ISOLATED TYPE.

SIRENITES, n. f. ind.

For the sake of completeness mention must be made here of a high-mouthed narrowly umbilicated *Sirenites*, which in the young may be compared with *Sirenites*, ind., illustrated on Pl. CLVII, Fig. 2, of the second volume of the "Cephalopoden der Hallstätter Kalke," from the Julian beds; but at a diameter of 40 mm. its lateral sculpture changes already in such a manner that from this point, on the chambered parts of the shell, it shows an undulation of falciform fine ribs in the middle of the sides similar to that of *Daphnites Zitteli* (Ceph. der Hallst. Kalke, II. Bd., p. 488, Taf. CLIX, Fig. 2).

The ribs which in the above-mentioned young stage are rounded become at the beginning of the full-grown stage flattened and completely smooth, whereby the intercostal furrows are reduced to sharp narrow incisions. But the fine numerous ribs soon become rounded again. A fragment of the body-chamber shows bundles of ribs near the umbilical margin similar to those of *Daphnites Zitteli*. Divisions of the ribs occur below the middle of the sides and on the outer margin.

Sutures.—These have a dolichophyll development. A more exact characterisation is not possible on account of the defective preservation of the shell.

Dimensions.—Not measurable.

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 3.

AMMONEA LEIOSTRACA.

A. ARCESTOIDEA.

a. ARCESTIDÆ.

1. ARCESTES, SUESS, Cf. *Arcestes*, E. v. Mojs., Cephalopoden der Hallstätter Kalke, Bd. II., p. 785.

I feel myself compelled to add to the four sub-genera *Proarcestes*, *Pararcestes*, *Arcestes*, s. str., and *Ptycharcestes* differentiated in the work above quoted, a fifth, *viz.*, *Stenarcestes*, which will comprise the group of *Subumbilicati*, up to the present referred to *Proarcestes* (Comptes rendus de l'Académie des Sciences, Paris, 18 November, 1895). The group of *Subumbilicati* occurring simultaneously with the true *Arcestes* shares the peculiarity with *Proarcestes*, *viz.*, that the last whorl, occupied by the body-chamber, retains the character of the inner chambered whorls. But as I have already mentioned in the description of the features of the group (Ceph. d. Hallst. Kalke, I. Bd., p. 142) there occurs, as a rule, a callus closing the umbilicus which in spite of this appears depressed, a feature foreign to *Proarcestes*.

The chief reason for regarding the group of *Subumbilicati* as an independent sub-genus is, however, offered by the sutures. They resemble, as already mentioned above, the sutures of the groups *Galeati* and *Intuslabiati* belonging to *Arcestes*, s. str., but they are distinguished by the bluntly pyramidal shape of the saddles wide apart at their base. The leptophyll denticulation of the saddles does not therefore reach to the base of the saddles, but is confined to their upper half. The extensive interlocking of the neighbouring septa is facilitated by the great width of the base of the saddles. While the sutures, with completely leptophyll denticulation, of the related groups of *Proarcestes*, *Pararcestes* and *Arcestes* show a euryphyll general course of outline, one could speak, according to the outline of the sutures, almost of a stenophyll course.

Stenarcestes occurs simultaneously with *Arcestes* in the Julian deposits of Europe for the first time and belongs with *Arcestes* to the most characteristic types of the Juvavian Stage.

I. STENARCESTES.

1. STENARCESTES, n. f. ind.

1895. *Stenarcestes*, n. f. ind., E. v. Mojs., Ammonites triasiques de la Nouvelle Calédonie. Comptes rendus de l'Académie des Sciences de Paris, 18 Nov.

This specimen, chambered throughout, is for the greater part of it a cast but some remnants of the shell are preserved, so that it may be seen that only inner shell ridges were present which on the cast appear as furrows.

The whorls which widely embrace one another are somewhat broader than high and possess rounded sides which gradually merge into the well-inflated external part. The umbilicus is very narrow. In the circumference of the last whorl there are three furrows on the cast which in the lower part of the sides show a slight concavity directed forwards but otherwise maintain a tolerably straight radial course. The furrow on the cast on the external side only shows a very inconspicuous curvature towards the anterior.

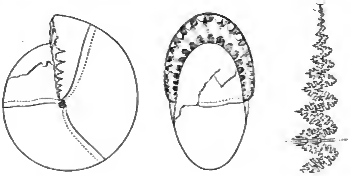
Of all European *Stenarcestes* *Stenarcestes Diogenis* (Mojs., Ceph. d. Hallst. Kalke, I Bd., Taf. LXVII, Fig. 4, Taf. LXVIII, Fig. 1, p. 145) mostly resembles the present form in outline, but no European form attains the same thickness.

As the body-chamber is unknown one must refrain from giving a special name to the form represented by this internal cast.

Sutures.—The suture-line unmistakeably shows close agreement with the type of sutures of the European *Stenarcestes*, but the features of this form would, however, offer no closer relationship to any of the named European species. There are eight auxiliary lobes present up to the umbilical suture. The deepest lobe is the external one, whose median projection shows the closest agreement with that of the European species. All the lobes terminate in one point and ascend gradually towards the umbilicus.

The saddles are very broad at the base and the septa succeeding one another interlock extensively. The leptophyll denticulation is confined to the upper halves of the saddles. The saddles terminate above, truncate with three short branches, the middle one of which appears bipartite by a short indentation. The external saddle possesses the same height as the first lateral one. From the second auxiliary saddle the leptophyll arrangement becomes completely obsolete in the broad and low auxiliary saddles.

Among the European species *Stenarcestes subumbilicatus* shows a close resemblance to the form under description. There are, however, several differences in the details of structure, as, for instance, the less depth of the external lobe, the more slender shape of the points of the saddles, the lack of the indentation in the middle branch of the points of the saddle and the finer character of the deeper lateral branches.



Stenarcestes, n. f. ind. Original in Jardin des Plantes in Paris. Reduced to 2/3 ; sutures natural size.

Dimensions.—

Diameter	73 mm.
Height of the last whorl	40 „
Thickness „ „ „	42 „
Width of the umbilicus	3 „

Locality and Geological Position.—In the dark limestone of New Caledonia (Muséum d'Histoire Naturelle du Jardin des Plantes in Paris). Number of specimens examined, 1.

II. ARCESTES, s. str., Group of ARCESTES INTUSLABIATI.

1. Arcestes Leonardi, E. v. Mojs., Pl. XX, Figs. 5—8.

On the casts of the inner chambered whorls the breadth of the whorls surpasses the height only slightly. The well-rounded external part merges in the similarly rounded sides. The umbilicus is narrow. In the circumference of one whorl there are three labiæ which arise through the direct imbrication of the old peristome over the shell as the latter increases in growth and expands anteriorly. On the inner side stronger thickenings (varices) correspond to the labia, by which the furrows on the cast appear deeper than those upon the shell. From the umbilicus the labiæ forming a cavite opening anteriorly in the lower part of the sides run to the anteriorly convex curvature, which is formed on the outer margin, after which they take their course in a straight line over the external part.

At the end of the penultimate whorl the characteristic bend of the whorl (Fig. 6), with which the change in the character of the whorl is introduced, occurs. Posteriorly to this bend is situated the last labium the external side of which coincides with the last septum, whilst the sutures on the sides of the last septum are situated anteriorly to this labium. The latter does not therefore coincide with the course of the sutures.

The last whorl of adult individuals (Fig. 5) shows a distinct increase in the height of the whorl, which is connected with a flattening of the sides as well as with the narrowing and levelling of the umbilicus.

The margin of the aperture bending inwards rests close upon the sides of the preceding whorl; the line of junction is nearly a straight one. The lumen of the peristome forms a right angle with bluntly rounded angles. On the external part the turned-in apertural margin forms a slight sinus, concave towards the anterior, so that a slight curvature convex forwards is formed by the blunt angles. The total length of the body-chamber comprises, besides the last whorl, about ½ of the penultimate whorl, as can be seen by a comparison of the two Figures 5 and 6.

Arcestes Leonardi is among known species most closely related to *Arcestes biceps* from the Lacic beds of the Salzkammergut and is distinguished from it by the open umbilicus.

Epidermidae.—Transversely running wrinkle-like striæ ("Wrinkle-layer") have been observed.

Sutures.—The suture-line given in Fig. 8 is taken from an adult form and is the last before the beginning of the body-chamber. The course and other details agree well with the character of the sutures of *Aroestes* of the Group of *Intuslabiati.* There are on the whole five saddles up to the umbilical sutures.

Dimensions.—

	Adult specimens.	*Internal casts.*
Diameter	29 mm.	19 mm.
Height of the last whorl	17 ,,	10
Thickness ,, ,, ,, ...	14 ,,	10·5 ,,
Width of the umbilicus	1·4 ,,	2 ,,

There are also somewhat larger forms which nearly reach the size of ***Arcestes biceps***.

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 14.

2. Arcestes subbicornis, E. v. Mojs., Pl. XX, Fig. 10.

This form shows a great resemblance to ***Arcestes bicornis***, Hau.[1], from the Tuvalian deposits of the Salzkammergut.

The shell, which belonged to a full-grown individual, shows an oviform elongated outline, a callus closing the umbilicus, and knee-angled bendings at the beginning of the body-chamber of the whorl on the preceding whorl (Fig. 10 *b*) here coinciding with the last labium, and an entire whorl later, posterior to the greatly depressed and narrowed peristome (Fig. 10 *a*).

The peristome shows two horn-like projections which laterally border the sinus whose concavity is directed forwards and which occurs on the external part. This peculiar structure of the apertural margin distinguishes the present form from ***Arcestes bicornis***, reminding one at the same time of ***Arcestes decipiens*** (Ceph. d. Hallst. Kalke, I Bd., p. 133, Taf. LIV, Figs. 2, 3) belonging to the same stratigraphical horizon.

Sutures.—Not known.

Dimensions.—

Diameter[2]	18 mm.
Height of the last whorl	10 „
Breadth „ „ „	9 „
Width of the umbilicus	0 „

Locality and Geological Position.—Carnic Stage; in the black limestone on the left side of Tera Gadh, north of Kalapani. Number of specimens examined, 1.

3. Arcestes, n. f. ind.

This fragment consisting of a body-chamber with the peristome belongs to a species of the group of ***Intuslabiati***, which might, from the shape of the peristome, be most closely related to ***Arcestes syngonus***, Mojs., from the Lacic marble of the Salzkammergut (Ceph. d. Hallst. Kalke, I. Bd., p. 123, Taf. XLVIII., Fig. 4).

The species attained a diameter of 101 mm. in the adult stage and had a callus closing the umbilicus. It was considerably narrower than ***Arcestes syngonus***.

A fractured portion of the fragment under description shows on the preceding whorl a well-preserved labium with a forwardly convex sinus on the external part.

Locality and Geological Position.—Juvavian Stage; in the limestone complex

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[1] E. v. Mojsisovics, Ceph. d. Hallst. Kalke, Bd. I, p. 127, Taf. XLVII, Fig. 4—6.

[2] Measured at the peristome, and therefore somewhat shorter than the greatest diameter at the knee-angled bending, which amounts to 18·5 mm.

(No. 6) with ***Pinacoceras*** cf. ***Imperator,*** of the Bambanag Section. Number of specimens examined, 1.

III. PROARCESTES, Group of PROARCESTES BICARINATI.

Proarcestes, n. f. ind.

The chambered internal casts show, so far as the imperfect preservation and the inadequate knowledge of the somewhat richly serrated suture-line allow an opinion to be formed, some resemblance to ***Proarcestes Gaytani*** v. Klipst. (Cf. E. v. Mojsisovics, Ceph. d. Hallst. Kalke, I. Bd., p. 100, Taf. LVIII, Figs. 1-3). As distinguishing features it might be mentioned that the sides do not possess the flattening characteristic of ***Proarcestes Gaytani,*** but appear flatly rounded. The larger casts show no traces of shell furrows or inner shell ridges (varices), whilst smaller casts exhibit two or three weak labiæ in the circumference of the whorl.

Sutures.—So far as a comparison of the suture-line is possible it seems to possess a rather close agreement with ***Proarcestes Gaytani.***

Dimensions.—

Diameter	84 mm.
Height of the last whorl	44 „
Thickness „ „ „	53 „
Width of the umbilicus	6 „

Locality and Geological Position.—Carnic Stage; in the Daonella beds of Lauka (pyritised and calcified) and Bambanag (calcified). Number of specimens examined, 4.

b. LOBITIDÆ.

1. Lobites, E. v. Mojs.

Cf. Cephalopoden der mediterranen Triasprovinz, p. 176—Cephalopoden der Hallstätter Kalke, Bd. I, p. 155.

Lobites Oldhamianus (Stoliczka).

1865. *Clydonites Oldhamianus*, Stoliczka, Mem. Geol. Surv. of India, Vol. V, Part I, p. 50, Pl. IV, Fig. 4.

1895. *Lobites Oldhamianus*, Diener, Palæontologia Indica, Ser. XV, Vol. II, Trias, Part II, p. 82, Pl. XXVII, Fig. 4.

It has already been mentioned in the introduction that this species could scarcely belong to the Anisic Stage, but belongs most probably to a horizon of the upper trias. For this reason it is spoken of here and attention is directed to the illustrations and descriptions cited above. It might well have been supposed that ***Lobites Oldhamianus*** was taken from a horizon of the Tyrolese Series and even from a

Carnic horizon, as up to the present time the Noric Stage has not been recognized in the Himálaya.

b. JOANNITIDÆ.

1. JOANNITES, E. v. Mojs.

1. JOANNITES, cf. CYMBIFORMIS (Wulfen), Pl. XX, Figs. 3, 4.

Joannites cymbiformis (Wulfen), E. v. Mojs., Cephalopoden der Hallstätter Kalke, Bd. I, p. 85, Taf. LXI, Figs. 1—5; Taf. LXII, Fig. 1, Taf. LXIII, Fig. 1; Taf. LV.

These specimens agree very closely with *Joannites cymbiformis*, as is to be seen from the figures of the small specimen of a cast and the suture-line. The presence of three furrows on the cast in the circumference of one whorl distinguishes *Joannites cymbiformis* from the closely related species *Joannites Joannis Austriæ*, which constantly in casts of the most variable dimensions only possesses two varices in the circumference of a whorl.

The few Indian specimens, however, which are before me, only show varices on a whorl up to 35 mm. in height, while species exceeding these dimensions did not show any varices at all. Whether in this the Indian species indicate characteristic features or merely individual differences cannot yet be decided on account of the small number of specimens suitable for examination. A further slight distinction from the typical examples of *Joannites cymbiformis* is shown in the slight curvature of the varices on the sides, but there also occur in Europe specimens which answer in this respect to the Indian casts. A close agreement with the European specimens is also shown by the Indian shells with reference to the dimensions attained. The largest individual present, which is chambered throughout, possesses a diameter of 142 mm.

Sutures.—The suture-line given in Fig. 4 agrees likewise in a remarkable manner with the sutures of *Joannites Joannis Austriæ* and *Joannites cymbiformis*. I am inclined to put to the account of individual variation the slight differences in the small details which may be observed on comparison with my illustrations of European forms. This variation is often seen in such complicated sutures and especially in the European specimens of *Joannites cymbiformis*.

The number of saddles outside the umbilical margin amounts to eight. The ninth saddle is on the umbilical margin.

Locality and Geological Position.—Carnic Stage; in grey limestone with *Traumatocrinus* and *Trachyceras tibeticum*, from Rimkin Paiar, 3 specimens; in the blackish-grey limestone with *Trachyceras* from the "cliff" opposite Ralphu glacier, left side of Lissar River, 1 specimen.

d. CLADISCITIDÆ.

1. Cladiscites, E. v. Mojs., Cf. v. Mojsisovics, Cephalopoden der mediterranen Triasprovinz, p. 173.

The genus *Cladiscites* is, according to our present knowledge, only represented in the Indian Trias Province by the group of *Subtornati*, which is distinguished from the group of *Tornati* by the peculiar formation of the first two lateral lobes. These two lobes, that is to say, reach in the *Subtornati* deep below the level of the group of lobes which gradually and evenly slope in an oblique line and are formed by the third lateral lobe and the auxiliary ones. In the group of the *Tornati*, on the other hand, such a difference in the development of the lobes does not take place and the first two lateral lobes and the external one are also arranged in the same manner as the group of lobes of the *Subtornati* formed by the auxiliary lobes and the third lateral one.

The group, therefore, of the *Subtornati*, to which, besides *Cl. subtornatus*, belong also *Cl. striatulus* and *Cl. subaratus* presently to be described, might be considered as a subgenus of *Cladiscites*, in which case the designation *Hypocladiscites* might be applied to it.

GROUP OF CLADISCITES SUBTORNATI (Hypocladiscites).

CLADISCITES SUBARATUS, E. v. Mojs., Pl. XX, Fig. 2.

This species shows in the outward shape, as also in the sutures, a great resemblance to *Cladiscites subtornatus* and was therefore recorded as *Cladiscites* cf. *subtornatus* in the geological report upon the Himálaya journey of Dr. C. Diener.

Distinctions as regards the outward shape are confined to the stronger inflation of the sides and the external part. Such a strong inflation shows itself in *Cladiscites subtornatus* only in the smaller shells representing a younger stage of growth. Specimens of *Cladiscites subtornatus* of the size of the present one of *Cladiscites subaratus*, which is chambered throughout, are more or less flattened on the external side as well as on the sides. The spiral ridges, moreover in *Cladiscites subaratus*, in specimens similar in size, are somewhat finer and more numerous than in *Cladiscites subtornatus*. Agreeing with this species the shell, sloping to the umbilicus and closed by a callus, is free from spiral ridges and perfectly smooth.

Sutures.—The most important distinctive feature, in contrast with *Cladiscites subtornatus*, is however offered by the sutures which, agreeing in general arrangement, show a considerably higher degree of denticulation. A richer development is in a striking manner especially shown in the first two large saddles. The large first lateral saddle whose inner upper chief branch rises unusually high also shows modifications in the number and arrangement of the lateral branches which can be better recognized by comparing the illustrations than by reading a description.

The number of the saddles up to the umbilical opening of the cast amounts to nine, the last seven of which in a regularly descending row succeed the large second lateral lobe which ends in a point. Remarkable also is the condition of the two lateral saddles which in contrast to the rest of the saddles and to the similar saddle of *Cladiscites subtornatus* appears not to be dimeroid in form, a circumstance which is to be considered as the result of the independent and extremely strong development of the outer upper branch of the saddle.

Dimensions.—

Diameter	119 mm.
Height of the last whorl	74 „
Thickness „ „ „	41 „
Width of the umbilicus	0 „

Locality and Geological Position.—Carnio Stage; in dark limestone of the Daonella beds of Lauka. Number of specimens examined, 1.

2. PARACLADISCITES, E. v. Mojs.

It has already been pointed out on a previous occasion (Cephalopoden der mediterranen Triasprovinz, p. 173) that the group of *Multilobati* is distinguished from the groups of *Tornati* and *Subtornati*, (as well as from *Procladiscites*, which all possess three lateral lobes, by the restriction of the lateral lobes to the number of two. The position of the lobes is therefore the normal one. The shell is smooth. Longitudinal ribs are absolutely wanting. Transversely running striæ of growth are, on the other hand, often noticeable. It seems to me advisable to express these variations in the sculpture and number of the lateral lobes by a special generic name. I therefore propose the generic designation *Paracladiscites* for the group of *Multilobati*. According to the present state of knowledge *Paracladiscites* appears in Europe for the first time in the Julian beds with *Lobites ellipticus*. The Indian specimens may in all probability be assigned also to the lower stage of the Julian beds.

The genus *Psilocladiscites* occurring in the lower stage of the Bosnian beds is to be regarded as the precursor of *Paracladiscites*; the former standing on account of the monophyll structure of the saddle in the same relation to *Paracladiscites* as *Procladiscites* does to *Cladiscites*.

1. PARACLADISCITES INDICUS, E. v. Mojs., Pl. XX, Fig. 1.

Ammonites Gaytani, MS. name.[1]

1892. *Cladiscites indicus*, E. v. Mojs., Vorläufige Bemerkungen über die Cephalopodenfaunen der Himalaya-Trias. Sitzungsberichte der kais. Akad. der Wiss., mathem.-naturw. Cl., Bd. CI., Abath. I., p. 376.

The absence of a flattening on the sides and on the external part makes the present form appear at first sight to be an internal cast of an Arcestid, while the dimeroid structure of the sutures leaves no doubt that one has to deal here with a form from the series of the *Cladiscitidæ.*

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[1] Under this designation there are, from the collection of the Geological Survey, two fragments named by Stoliczka, one of which belongs to *Paracladiscites indicus*, but the other, undeterminable, to the species next to be discussed.

The non-umbilicated whorls, completely embracing one another, are considerably wider than high. No sharp separation takes place between the external part and the sides but the inflation of the external part gradually merges in the swelling of the sides. Also towards the callus closing the umbilicus the sides are rounded down to the steeply descending umbilical wall. The shell of which there are remnants on the sides and external part is completely smooth.

To all appearance the same, or at least a very closely related species occurs in the Julian beds with *Lobites ellipticus* of the Feuerkogel, on the Röthelstein, near Aussee. This species is represented by two specimens which will be figured in the supplement to the first volume of my "Cephalopoden der Hallstätter Kalke." The larger specimen possesses at a diameter of 75 mm. half a volution of the body-chamber, while the smaller specimen, chambered throughout, shows coarse transversely running "wrinkle" striæ upon the smooth shell.

Sutures.—The total number of the lobes cannot be exactly ascertained for the reason that the umbilical part could not be completely exposed. There are five dimeroid-shaped saddles, slightly indented, up to the steep descent of the umbilical wall, as is shown in our illustration taken from the posterior part of the last whorl.

In the specimens mentioned from the Feuerkogel there are about six saddles visible, somewhat more slender, which however may be the result of their more considerable dimensions.

Dimensions.—

Diameter	36	mm.
Height of the last whorl	21	,,
Thickness ,, ,, ,,	26	,,
Width of the umbilicus	0	,,

Locality and Geological Position.—From the black clayey limestone of Kuling in Spiti probably belonging to the Daonella beds. Number of specimens examined, 1.

2. Paracladiscites, n. f. ind.

Ammonites Gaytani, Stoliczka, MS. name.

This is a fragment, not sufficient for description and illustration, of another species which by the flattening of the sides seems to be allied to the still undescribed *Paracladiscites timidus* from the Feuerkogel, near Aussee.[1]

The diameter of the fragment, which has a perfectly smooth shell and is chambered throughout, amounts to 40 mm.

Sutures.—Not known in detail.

Locality and Geological Position.—From the black limestone of Kuling in

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[1] The quotation of *Ammonites Gaytani* (Mem. Geol. Sur. of India, Vol. V, p. 53) by Stoliczka may well have been based upon this fragment.

Spiti belonging probably to the complex of the Daonella beds. Number of specimens examined, 1.

B. PINACOCERATOIDEA.

a. PINACOCERATIDÆ.

PINACOCERAS, E. v. Mojs., cf. Cephalopoden der mediterranen Triasprovinz, p. 195.—Cephalopoden der Hallstätter Kalke, I. Band, p. 41.

1. PINACOCERAS PARMA, E. v. Mojs., Pl. XVIII, Figs. 7, 8.

1873. Pinacoceras parma, E. v. Mojs., Das Gebirge um Hallstatt, I, Bd., p. 60, Taf. XXVI, Fig. 2.
1873. Pinacoceras sub-parma, E. v. Mojs., l. c., p. 61, Taf. XXVI, Fig. 3.

The differences between *Pinacoceras parma* and *Pinacoceras subparma* are so slight that it seems to me to be more advisable for the present to regard *Pinacoceras subparma* as only a variety of *Pinacoceras parma*. *Pinacoceras subparma*, that is to say, is only distinguished by the small accessory saddle occurring in the first (external) auxiliary lobe. This saddle, as a comparison with *Pinacoceras parma* shows, can only be regarded as the freed large outer accessory branch of the first auxiliary saddle. A further difference between the two forms mentioned consists in the more slender form of the principal saddles in *Pinacoceras subparma*.

The present Indian specimens are individuals of moderate dimensions and chambered throughout. The shape agrees with that of the shell in the European specimens of the *Metternichi* group. The extraordinarily narrow shell, with contracted umbilicus and therefore closely embracing whorls, forms a narrow knife-like edge on the external part which on its inner side on the chambered part of the shell forms a tube which is bounded by the chambered lumen.

The shell is either quite smooth or shows only slight indications of falciform folds when viewed with the light falling obliquely upon it.

Sutures.—The sutures are, as our illustration indicates, in the closest agreement with those of the European specimens. There are five adventitious, three principal and eight auxiliary lobes. The first adventitious saddle shows the large outer accessory branch, as in the typical specimens of *Pinacoceras parma*. The principal saddles possess the more slender, pyramidal form, as in the figured variety of *Pinacoceras subparma*. The greater height of the principal saddles may in both cases be connected with the more youthful stage of growth from which the drawings of the sutures were taken. In the more advanced stage, as has often been stated, the saddles may have been more widened and therefore have lost in height.

The number of the auxiliary saddles outside the umbilical margin amounts to eight, being thus somewhat fewer than in the rest of the larger European specimens. This distinction may also be attributed only to the more youthful stage of growth of the Indian specimens.

Dimensions.—

Diameter	84 mm.
Height of the last whorl	45 „
Thickness „ „	10 „
Width of the umbilicus	8 „

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 2.

2. PINACOCERAS, indet., Pl. XIX, Fig. 1.

The figured fragment which has suffered on both sides from weathering is unfortunately only sufficient to establish its ascription to the series of forms of ***Pinacoceras imperator***, which begins in the lower stage of the Bosnian beds with ***Pinacoceras Damesi*** and dies out with ***Pinacoceras imperator*** in the Sevatic deposits.

As the front view, Fig. 1 b., shows, the septal unfolding is very slight though the number of auxiliary lobes is very considerable. In consequence of this a very deep sinking back of the auxiliary lobes takes place in the manner of an umbilical lobe extending far back. According to this view the character of the external part of the preceding whorl can also be assumed. The blunt edge of the shell rising like a hollow keel over the external flattened chambered cast is distinctly to be seen.

It does not seem as if the present fragment could be referred to a known species. Neither can it be decided with certainty whether it is nearer to the Carnic ***Pinacoceras Rex***, or the Juvavian ***Pinacoceras imperator***.

The large dimensions and the slight curvature of the suture-line might, it is true, indicate that we have to deal here with a species closely related to ***Pinacoceras imperator***.

The number of the adventitious lobes cannot be given. The number of the auxiliary lobes distinguished by their small size amounts to twelve for the portion lying outside the rectangular umbilical edge.

Locality and Geological Position.—Juvavian Stage; in the Limestone complex No. 6 (Haucrites beds) of the Bambanag Section. Number of specimens examined, 1.

2. BAMBANAGITES, E. v. Mojs.

The high-mouthed disc-shaped shells are provided with falciform folds, which are close together on the external part, and this is blade-like in the young, being sometimes ornamented with external tubercles and flattened on the body-chamber in the adult.

The suture-line consists of three adventitious, two principal and a number of auxiliary lobes and slightly serrated saddles, rounded above in a monophyll manner. A dimeroid bifurcation is here and there indicated in the auxiliary saddles, in which case the saddles attain double the width of the otherwise very narrow saddles. The adventitious lobes show a slight ascent. The first principal lobe reaches the greatest depth and width. On the side walls of the adventitious and chief saddles there are a few lateral branches which show an inclination towards a phylloid rounding.

Bambanagites, it is true, reminds us of *Pinacoceras Layeri* by its sculpture, but it cannot however be considered a descendant of Pinacoceras on account of the simple and primitive structure of its sutures. On the other hand it is very probable that both genera—*Bambanagites* and *Pinacoceras*—originate from a common root, and according to our knowledge of the development of the phylloid type of sutures the immediate ancestors of *Pinacoceras* might have possessed sutures similar to those of *Bambanagites.*

The length of the body-chamber amounts to somewhat more than half of the last whorl.

Bambanagites is so far only known from the Halorites Limestone of the Himálaya.

1. Bambanagites Schlagintweiti, E. v. Mojs., Pl. XVIII, Figs. 1, 2.

The chambered parts of the shell show closely embracing, very narrowly umbilicated and high-mouthed whorls, whose slightly inflated sides merge into a truncated, blade-like external part having an uninterrupted margin. The shell is almost completely smooth on the inner whorls. In the specimen represented in Fig. 2 some faint traces of falciform folds occur only at the end of the last whorl. Also the large form, Fig. 1, with the body-chamber preserved, shows at the beginning of its last whorl only a faint sculpture, which attains its full strength only later on.

On the body-chamber which occupies somewhat more than half of the last whorl there occurs a change in the shape of the volution, for the external part, which still forms a blunt blade in the posterior third of the last whorl, gradually widens and becomes rounded to present itself finally, at the end of the body-chamber, as a well-characterized slightly inflated area, separated from the sides by rounded edges. Simultaneously with this characterisation of the external area there also occurs a flattening of the sides.

As at the aperture, the lower part of the sides on the left half of the shell somewhat projects, it is to be supposed that here practically the mouth-margin which agrees in its course with the direction of the sculpture is present.

The sculpture of the body-chamber whorl consists of falciform folds which are divided into two regions of varying strength by a spiral line running above the middle of the sides. Thus on the lower area, extending towards the umbilicus, the folds are extraordinarily weakly developed. Somewhat outside the anteriorly convex projection, or rather at the same place at which the spiral line runs, a strengthening of the sculpture occurs. On the anterior portion of the body-chamber provided with the flattened external part the broad flattened fold-like ribs unite together on this external area coming from both sides. Very often there are no bifurcations of the fold-like ribs in the region of the spiral line. Fusions of the fold-like ribs in the anterior part of the body-chamber may also be mentioned as occurring on the spiral line as well as outside of it.

It is necessary to direct attention to the fact that the anteriorly convex arch which distinguishes the middle of the falciform curvature of the fold-like ribs forms a lappet at the sides, reaching beyond the external part. The latter therefore shows, in comparison to this lateral lappet, a backwardly directed sinus.

Sutures.—Besides the three adventitious lobes there are to be counted two lateral and from eight to nine auxiliary ones situated outside the umbilical margin. The external adventitious lobe which takes the place of the external lobe is divided by a wide median projection into two halves, which are divided again by a small denticle into two points. The two following adventitious lobes are one-pointed.

The first lateral lobe is divided by two projecting denticles into three points. It is therefore rather wide and reaches the greatest depth of all the lobes, for at the side of the adventitious lobes as well as at that of the second lateral and the auxiliary ones an ascent of the lobes takes place. The second lateral lobe is two-pointed and the auxiliary lobes appear indistinctly rounded. They are mostly very narrow. Their number cannot be exactly fixed, for the reason that one remains in doubt whether some shorter indentations dividing the saddles are to be regarded as lobes or as divisions of the saddles.

The saddles increase in height up to the first lateral saddle, which reaches the greatest height, and decrease in height rapidly towards the umbilicus. They end above with a large "leaf," which only in the second and third adventitious saddles as well as in the first lateral one shows traces of slight notches. Also the little lateral branches of the larger saddles show a tendency to the phylloid structure. The auxiliary saddles have no lateral branches.

Dimensions.—

Diameter	80 mm.
Height of the last whorl	44 „
Thickness „ „	17 „
Width of the umbilicus	3 „

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 2.

2. BAMBANAGITES DIENERI, E. v. Mojs., Pl. XVIII, Figs. 3—6.

The series of variations of this beautiful species shows such remarkable deviations in the character of the sculpture that one might be induced to make out several different species. Nevertheless closer investigation shows that the differences so striking in the extreme varieties are connected by gradual transitions. It is also shown that the variability is so great that each of the specimens under description shows certain peculiarities by which it is distinguished from the rest.

Bambanagites Dieneri resembles in the form of the whorls the closely related *Bambanagites Schlagintweiti*, from which, however, it is distinguished essentially by the much smaller dimensions and the beginning of the sculpturing already occurring on the chambered parts. Another feature separating the two forms, so far not connected by any transitional form, is afforded by the characteristic external tubercles which distinguish *Bambanagites Dieneri* but are likewise only present in a small degree in individuals with faintly developed sculpture. These external tubercles are caused by the union of the fold-like ribs on the blade-like edge of the external side coming from both sides of the shell. On the body-chambers of adult specimens these external tubercles are obliterated simultaneously with the gradual beginning of the rounding and flattening of the external part.

The variability in the strength of the sculpture can be seen in our illustrations. In one of the most extreme individuals, Fig. 3, actual pits are visible on the posterior side of the folds on the anteriorly convex sharp bending of the folds. The latter are wide and strongly developed and, bifurcating once or twice, run to the external part in an anteriorly concave arch. The shell on the lower half of the sides appears almost smooth.

The sculpture in the form represented in Fig. 4 is less strongly developed. The folds take more the character of ribs which outside the spiral, dividing the sculpture on the sides, do not as a rule bifurcate at all, or only once, but exceptionally also twice. The rarer occurrence of bifurcations is caused by the fact that the number of the folds running from the spiral division is a larger one.

The form, Fig. 5, is distinguished by the complete characterisation of the ribs which present themselves here as transverse folds. Single ribs, especially on the body-chamber, appear to be longitudinally divided in the vicinity of the outer margin.

The sculpture in the individual represented in Fig. 6 appears very much weakened.

Sutures.—The suture-line (Fig. 6^{c}) shows great general agreement with the sutures of *Bambanagites Schlagintweiti*. Remarkable however is the slight depth of the second adventitious lobe, as well as the development of the auxiliary saddles into dimeroid saddles. It seems as if by a fusion of every two neighbouring simple auxiliary saddles of the type of the auxiliary saddles of *Bambanagites Schlagintweiti* the dimeroid-shaped auxiliary saddles of *Bambanagites Dieneri* were developed. In harmony with this view may also be mentioned the small number of auxiliary saddles occurring in *Bambanagites Dieneri*, of which only four can be observed up to the edge of the umbilicus. *Bambanagites Schlagintweiti* possesses double the number of auxiliary saddles.

Dimensions.—

Diameter	54 mm.
Height of the last whorl	31 „
Thickness „ „	12 „
Width of the umbilicus	2 „

Locality and Geological Position.—Juvavian stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 7.

3. PLACITES, E. v. Mojs.

1873. Gruppe des *Pinacoceras platyphyllum*, E. v. Mojs., Das Gebirge um Hallstatt, I. Heft, p. 49.
1866. *Placites*, E. v. Mojs., Über den chronologischen Umfang des Dachstein kalkes. Sitzungsber. der kais. Akad., math.-naturw. Cl., Bd. CV., Abth. I., p. 18.

It seems to me advisable to separate this group, distinguished by a rounded external part and a small number of adventitious lobes, from the typical Pinacoceratidæ under a special generic name.

The high-mouthed shells are in the Carnic species narrowly umbilicated, but they are as a rule in the Juvavian forms, on the other hand, un-umbilicated (*i.e.*, closed by a callus).

In the greater number of forms there is only one (external) adventitious lobe, which is succeeded by two large principal lobes, the second of which is generally the most deeply reaching one and therefore corresponds to the first lateral lobe of the Ammonites, without adventitious lobes. Only in *Placites perauctus* there are three adventitious lobes, and this type comes nearest to the typical Pinacoceratidæ on account of the dimeroid structure of the adventitious saddles. It is very noteworthy that the adventitious lobes, which occur besides the external adventitious lobe, develop themselves from the adventitious saddle by bifurcation. The adventitious saddle may be dimeroid or one-pointed. Of the two chief saddles the first is always one-pointed, the second being in most cases also so. Only the succeeding saddles are dimeroid.

Placites shows a great outward resemblance in its shape to involute *Gymnites*, for example, to *Gymnites subclausus*, Hauer, from the Bosnian Stage.[1] The analogy is essentially strengthened by the fact that the indication of an adventitious lobe also exists in this species in consequence of the bifurcation of the external saddle.

The question as to the possible derivation of the genus *Placites* from *Gymnites*, widely umbilicated in their older representatives, but visibly more narrowly umbilicated in their younger ones, must for the present be left open.

But I should like to draw attention here to analogies which seem to bring *Placites* into relationship with certain Cladiscitidæ. Putting aside the spiral striation, *Procladiscites Brancoi*, *Hypocladiscites subaratus* and *Hypocladiscites subtornatus* not only show a certain agreement in outer form, but also in the disposition of the sutures. With reference to the latter one may for instance compare the sutures of *Placites Oldhami* (Pl. XIX, Fig. 2) with the lobes of the above-named Cladiscitidæ. The first two deep lateral lobes find their corresponding representatives in the two large principal lobes of *Placites*. I am inclined to think that a greater significance ought to be attached to the analogies with the Cladiscitidæ than to the resemblances with *Gymnites*. Nevertheless I deem it advisable to hold my opinion about it in suspense.

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[1] Denkschr. der kais. Akad. der Wissensch., math.-naturw. Cl., Bd. LIV, p. 33, Taf. VII, Fig. 5.

True *Placites* occur, according to our present knowledge, for the first time in the Julian period. The genus reaches specially rich development, however, only in the Juvavian Stage, at the end of which it also dies out.

2. PLACITES, ind. ex aff. Pl. PERAUCTI, Pl. XVIII, Fig. 9.

1873. *Pinacoceras perauctum*, E. v. Mojs., Das Gebirge um Hallstatt, I. Bd., p. 68, Taf. XXI, Figs. 7, 8.

The undeterminable chambered fragment belongs to a species related to *Placites perauctus*, as is shown by the occurrence of three adventitious lobes. This type is already found in the Mediterranean Trias Province of Europe, in the Julian deposits; but these latter occurrences (cf. loc. cit. *Pinacoceras* cf. *perauctum* p. 53) are likewise imperfectly known.

Locality and Geological Position.—Carnic Stage; in the upper Daonella Beds of the Bambanag Section. Number of specimens examined, 1.

2. PLACITES OLDHAMI, E. v. Mojs., Pl. XIX, Fig. 2.

The high-mouthed smooth shell possesses an umbilicus with a narrow opening, which is bordered by a steep umbilical wall. The sides are very flat and scarcely perceptibly inflated. The external part is rounded.

Sutures.—According to the structure of the sutures *Placites Oldhami* is to be assigned to the group of *Placites platyphyllus*. Decisive for this allocation is in the first place the adventitious saddle, with its low lateral branch attached to its outer side in an oblique position. This branch, as the Mediterranean forms of *Placites* show, is to be regarded as a rudimentary, smaller, adventitious saddle. The character also of the auxiliary saddles which do not show the deep bifurcation characteristic of the group of *Placites symmetricus* does not contradict this ascription to the group of *Placites platyphyllus*. But it is to be observed that the outer lateral branch, mentioned above, is proportionally weakly developed and does not attain the dimensions which are reached by the Mediterranean species of the same group, though belonging to a higher horizon.

The external lobe, designated here the adventitious lobe in harmony with the terminology applied to the European species, is considerably shallower than the two succeeding chief lobes, and divided into two diverging two-pointed halves by a trapeze-like median projection.

The second of the two large principal lobes which performs the function of the first lateral lobe of Ammonites with normal sutural arrangement reaches somewhat lower than the first. Both are two-pointed at their base. But smaller denticles indicate at the base of the first principal lobe a further division of the two chief points.

The first of the twelve successive lobes, descending arch-like to the umbilical suture, performs the function of the second lateral lobe (*i.e.*, the third principal lobe), though it appears outwardly already as auxiliary lobe; while the other eleven are to be regarded as true auxiliary lobes. The larger of them are divided into two points, but a division cannot be observed in the smaller ones. The saddles are rather simply constructed and the dimeroid arrangement is only shown in the auxiliary saddles. The first principal saddle reaches the greatest height.

Dimensions.—

Diameter	45 mm.
Height of the last whorl	26 „
Breadth „ „	9 „
Width of the umbilicus	2 „

Locality and Geological Position.—Carnic Stage; in the Daonella beds of Lauka. Number of specimens examined, 1.

3. PLACITES SAKUNTALA.—E. v. Mojs., Pl. XIX, Figs. 3, 5.

This species is distinguished from *Placites Oldhami* by the umbilicus closed with a callus, the stronger inflation of the sides and the differently shaped, richly denticulated sutures.

Faint falciform transverse striæ are shown (Fig. 5) on the shell, which is in good preservation. They describe a widely expanding arch, anteriorly convex, on the upper half of the side, similar to that in the genus *Bambanagites.*

Sutures.—Placites Sakuntala represents, having regard to the structure of the sutures, an independent type which cannot be included, without reservation, in any of the groups differentiated up to the present time in the Mediterranean trias. *Placites polydactylus* (Cephal. der Hallst. Kalke, I. Band, p. 52, Taf. XXI, Fig. 4) shows the greatest resemblance in the structure of the lobes, but there are also many remarkable differences between this form and the present one. Thus *Placites polydactylus* possesses the outer lateral branch on the adventitious saddle characteristic of the group of *Placites platyphylli,* whereas in *Placites Sakuntala* this branch is, as a rule, completely absent.

The three drawings given of the sutures show the mode of development in the different stages of growth. It is seen that the growth of the new sutural elements takes place from the side of the umbilicus. The increase of the denticulation and characterisation with age are also to be observed.

The small size as well as the almost symmetrical form of the adventitious saddle are very remarkable, the externally situated lobe being thereby proportionally deep. The two large principal lobes reach nearly the same depth. The first of the eight lobes, descending to the umbilicus in a series of auxiliary lobes, is, from its relations to the preceding whorl, still to be regarded as a lateral or principal lobe.

As an important distinctive point compared with *Placites polydactylus* it is to be observed that only the large first principal saddle shows the wedge form. The dimeroid shape of the saddles begins therefore already with the second principal saddle. The second principal saddle in *Placites polydactylus* has on the other hand a wedge-shaped outline quite similar to that of the first principal saddle.

One of the specimens under description which we regard as a variety of *Placites Sakuntala*, is distinguished from all the other forms by the presence of the above-mentioned outer lateral branch on the adventitious saddle. Through this circumstance we get an indication that *Placites Sakuntala* might nevertheless be in closer relationship with the group of *Placites platyphylli* than would otherwise be supposed.

Siphuncle.—Almost all the specimens under examination possess a cord running uninterruptedly and representing a well-preserved siphuncle. There was therefore most probably a horny siphonal covering present.

Dimensions.—

Diameter	40 mm.
Height of the last whorl	25 „
Thickness „ „	10 „
Width of the umbilicus	0 „

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 14.

b. MEGAPHYLLITIDÆ.

1. MEGAPHYLLITES, E. v. Mojs.

1878. Dolomitriffe von Südtirol und Venetien, p. 48.
1879. Vorläufige Uebersicbt der Ammoniten-Gattungen der Trias. Verh. der k. k. Geol. R. A., p. 135.
1882. Cephalopoden der mediterranen Triasprovinz, p. 191.

Of this genus so widely distributed in the Mediterranean trias only a single fragment, rather imperfectly preserved, but undoubtedly generically connected with it, has been found in the Indian trias. In Europe *Megaphyllites* belongs to the more numerous specimens, especially in the deposits poor in clay, of the Cephalopodfacies. Whether their rarity in the Himálaya is connected with the prevalence of the Cephalopod-bearing rocks richer in clay, or whether it may be attributed to the local peculiarities of the Indian Trias Province, must for the present remain an open question.

MEGAPHYLLITES, f. ind.

Cf. *Megaphyllites Jarbas*, Münster E. v. Mojsisovics, Cephalopoden der Hallstätter Kalke, Bd. 1. p. 47, Taf. XIX, Figs. 9, 10, 16. Cephalopoden der mediterranen Triasproviuz, p. 193, Taf. LIII, Figs. 7, 8.

This chambered cast converted into brown ironstone only possesses a diameter of 11·5 mm. and has suffered by weathering. A specific determination is therefore not attainable. The shape of the shell reminds us most strongly of

Megaphyllites Jarbas, and the sutures also, though damaged by weathering, well admit of comparison with that species. The only specimen present comes from the slates of the Daonella beds to the south of the Uttadurrha Pass.

c. LYTOCERATIDÆ.

1. MOJSVARITES, Pompecky.

1882. *Monophyllites*, E. v. Mojs., *pro parte*, Cephalopoden der mediterranen Triasprovinz, p. 204.
1895. *Mojsvarites*, Pompecky, Ammoniten des Rhät. Neues Jahrb. fur Min., Geol. u. Paläont. II. Bd., p. 19.

MOJSVARITES EUGYRUS, E. v. Mojs., Pl. XIX, Fig. 7.

1873. *Lytoceras eugyrum*, E. v. Mojs, Das Gebirge um Hallstatt, I. Bd., p. 34, Taf. XIX. Figs. 12, 13.

This form with its numerous slowly increasing whorls agrees perfectly with the specimens from the Julian Hallstatt Limestone of the Feuerkogel near Aussee, but the thickness of the whorls appears too great and consequently also the inflation of the sides much too conspicuous in the illustration here given (Fig. 7b), which represents the anterior somewhat crushed portion of the last whorl restored.

Sutures.—In spite of the smaller size the finer details at the base of the first lateral lobe and the lateral branches of the first lateral saddles are distinctly perceptible when compared with *Mojsvárites Agenor* (Cf. *Monophyllites Agenor*, E. v. Mojsisovics, Ceph. d. mediterranen Triasprovinz, p. 205, Taf. LXXVIII, Figs. 6—9).

Dimensions.—

Diameter	13	mm.
Height of the last whorl	4·4	„
Breadth „ „ „	3·5	„
Width of the umbilicus	5·8	„

Locality and Geological Position.—Carnic Stage; in the Daonella beds (No. 5) of the Bambanag Section, 1 specimen; in the same beds near Kiangur, 1 specimen.

2. PHYLLOCERAS, Ed. Suess.

1865. *Phylloceras*, Ed. Suess, Ueber Ammoniten. Sitzungsber. der kais. Akad., math.-naturw. Cl., Bd. LII, Abth. I, p. 66.
1873. *Phylloceras*, E. v. Mojs., Das Gebirge um Hallstatt. I. Bd. I. Heft, p. 36.
1885. *Racophyllites*, K. A. v. Zittel, ex parte, Handbuch der Paläontologie, Bd. II., p. 439.
1889. *Racophyllites*, Steinmann, ex parte, Paläontologie, p. 420.

I consider the triassic forms which are grouped round *Phylloceras neojurense* as the direct ancestors of the jurassic Phylloceratidæ, whilst v. Zittel and Steinmann assign these triassic forms to the genus *Racophyllites* and regard the genus *Megaphyllites* as the primitive form of the genus *Phylloceras*.

With reference to the genus *Megaphyllites* emphasis must be laid upon the circumstance that all the Carnic and Juvavian species are un-umbilicated (closed with a callus) and always provided with exclusively one-leafed terminations of the saddles. The genus *Phylloceras* possesses an open umbilicus, and it is most improbable that its ancestors were un-umbilicated. Forms which would make a transition from the one-leafed saddles of the genus *Megaphyllites* to the saddles of the genus *Phylloceras* terminating in two or three leaves are moreover entirely wanting. Its concentrated proportions of growth connected with its small size, a circumstance that is according to my experience to be observed only in dying-out stocks (compare the genera *Parapopanoceras*,[1] *Nannites*, *Lobites*, *Tropicellites*, *Styrites* and *Celtites*) is another remarkable peculiarity of *Megaphyllites*. I consider *Megaphyllites* as a genus becoming extinct without descendants at the uppermost trias boundary.[2]

Phylloceras neojurense and its contemporaries from the same group are distinguished from the typical representatives of the genus *Phylloceras*, as for instance from *Phylloceras heterophyllum*, only by the wider umbilicus and the smaller number of the auxiliary lobes connected with the lesser degree of involution. The genetic development of involute forms out of evolute ones is among the Nautiloids and Ammonoids however such a generally recognised phenomenon that to enlarge upon it would be rather superfluous. But attention may here be drawn to the studies of M. Neumayr[3] on the ontogenetic development of different jurassic species of *Phylloceras*. The sutures of *Phylloceras neojurense* are the typical *Phylloceras* sutures, and it need only be pointed out that only the three chief saddles on each half of the shell show the diphyll or triphyll termination of the saddles, while the succeeding ones are always monophyll. This feature is evidenty connected with the slight degree of involution of the shell.

Out of the evolute species of *Phylloceras* are developed on the one hand the strongly involute typical species of *Phylloceras* of the Jura, and on the other hand the sub-genus *Rhacophyllites*, Zittel, which is distinguished by inclined auxiliary lobes and a variable body-chamber and is confined to the lias.

Phylloceras descends, as I already mentioned in the year 1873,[4] from the triassic ancestors of the genus *Lytoceras*, which I have later distinguished as *Monophyllites*.

Of the two stocks which I have designated as *Monophyllites*, the series of forms of *Monophyllites sphaerophyllus* or *Monophyllites* s.s. may be regarded as precursors of the genus *Lytoceras*, and the group of *M. Agenor*, distinguished by Pompecky under the generic name *Mojsvárites*, as the source of the genus *Phylloceras*.

Transitional forms between *Mojsvárites* and *Phylloceras*—forms that may be attributed to one or the other of these genera at discretion—are *Phylloceras patens* from the Lacic Hallstatt Limestone and the Indian *Phylloceras Ebneri*, which will be described below.

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[1] I agree with Haug's proposal to separate from the permian Popanoceratids the Popanoceratids described by me from the Arctic trias, under the generic designation *Parapopanoceras* forms which are already completely in the Ammonitic stage of development.

On the other hand it is incomprehensible to me that Haug should place the two genera so closely allied and in direct descent in two different sub-orders, and that thus *Popanoceras* should be put in the sub-order *Triaenidia* and *Parapopanoceras* in the sub-order *Prionidia*.

[2] Pompecky, Ammoniten des Rhät. Neues Jahrb.—für Mineral, etc., 1895, Bd. II., p. 23.

Jahrb. Geol. R. A., 1871, p. 305.

[4] Gebirge am Hallst. Bd., I. Heft, p. 36.

The genus *Phylloceras* occurs, according to the range here adopted, for the first time in the Julian beds.

PHYLLOCERAS (MOJSVARITES) EBNERI, E. v. Mojs., Pl. XIX., Fig. 6.

This species is, like *Phylloceras* (*Mojsvarites*) *patens*, a transitional form from *Mojsvarites to Phylloceras* and depends upon an arbitrary decision as to whether it is to be referred to the one or to the other genus. The slowly increasing whorls only embracing one another on the external part are higher than wide and possess a smooth shell. The external part is narrowly inflated and gradually passes into the gently-rounded sides. The umbilical margin is rounded, its wall overhanging. The umbilicus is, in consequence of the slight involution, widely opened.

Phylloceras Ebneri is distinguished outwardly only very slightly from the closely related *Phylloceras patens* occurring in the Lacic division of the Juvavian Hallstatt Limestone (*Lytoceras patens*, E. v. Mojsisovics, Ceph. d. Hallstätter Kalke, I. Bd., p. 84, Taf. XVI., Fig. 13, Taf. XIX., Fig. 17) by the somewhat different transverse section of the whorls caused by their lesser height.

Sutures.—The ill state of preservation which makes the present fragment very fragile unfortunately prevents the complete exposure of the external saddle. It seems, however, that this was similarly shaped to that of *Phylloceras patens* and that thus it was monophyll, provided with a large terminal leaf, rounded above, the convexity of which was directed towards the first lateral lobe, but the concavity towards the external lobe. A second deeper-lying leaf, which, however, did not reach the height of the large terminal leaf, seems to have been turned towards the external lobe. The beginning of the diphyll development is therefore indicated also on the external saddle, in spite of the monophyll plan here unmistakable. The character and the depth of the external lobe could not unfortunately be observed.

The two lateral saddles are distinctly diphyll. But the somewhat stronger development of the outer terminal leaf, which is especially observable in the second lateral saddle, recalls its monophyll origin.

The lobe situated on the umbilical margin is to be regarded as the third lateral lobe, according to its position in relation to the projection of the preceding whorl. The first lateral lobe which reaches the greatest depth is arranged in three larger points divided by denticles with entire margins; the middle and deepest of these points is subdivided again by smaller denticles and points. The outer point also shows a secondary serration at its base. The second lateral lobe is provided with two larger points, which are again divided. The character of the third lateral lobe is not distinctly observable.

The suture-line as described differs in the details of the lobes and the lower portion of the saddles from the lobes of *Phylloceras patens*, as may be seen from a comparison of the figures.

Dimensions.—

Diameter	74 mm.
Height of the last whorl	29 ,,
Thickness ,, ,, ,,	22 ,,
Width of the umbilicus	27 ,,

Locality and Geological Position.—Carnic Stage; in the Daonella beds of Lauka. Number of specimens examined, 1.

d. PTYCHITIDÆ.

1. PTYCHITES, E. v. Mojs, Cf. Cephalopoden der mediterranen Triasprovinz, p. 244.

PTYCHITES POSTHUMUS, E. v. Mojs., Pl. XIX., Figs. 8, 9.

Whilst the suture-line is of such a character as to admit of no doubt that we are dealing in the present form with a *Ptychites*, the last whorl (Fig. 9) consisting of the body-chamber for the greater part shows some divergence on account of which we cannot determine whether we have to deal with originally organic or late mechanical deformations.

After the bending of the last whorl, which reminds us of the bendings of the whorl at the beginning of the body-chamber in *Arcestes*, a deviation from the spiral takes place with a turn to the left.[1] A depression of the whorl occurs simultaneously. The margin of the mouth is, it is true, not preserved, but the specimen of the body-chamber (Fig. 9) is to be regarded as nearly complete, as it almost occupies the whole of the last whorl. The cast of the inner chambers (Fig. 8) completely recalls the Rugifer type. The spherical shell possesses a narrow umbilicus, bordered by a sharp edge and shows faint traces of transverse folds.

Sutures.—The external lobe is proportionally deep, reaching nearly to the depth of the first lateral lobe. It separates itself, it is true, by this feature from the character of this lobe in the geologically older typical Rugifers. But the narrow fine external saddle, appearing somewhat too wide in our illustration, thoroughly recalls the Rugifer type, though it must be admitted that the present small species shows a tendency to a more distinct characterisation of the external lobe and saddle. The two lateral saddles and the two following auxiliary saddles are bifurcated in the middle into two parts. The external saddle terminates above in two lappets, and the first lateral saddle in three.

Dimensions.—In consequence of the imperfect preservation preventing a reconstruction the usual measurements are not possible in the body-chamber specimen. We must therefore be content to mention that the diameter at the place of the knee-shaped bend amounts to 21 mm.; and that more anteriorly, after the beginning of the depression in the region of the mouth, it is only 20 mm.

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[1] *N.B.*—The drawing which is done without the help of a mirror is reversed.

Internal casts give the following measurements :—

Diameter	14·5 mm.
Height of the last whorl	7·5 ,,
Thickness ,, ,, ,,	10·5 ,,
Width of the umbilicus	1·5 ,,

Locality and Geological Position.—Carnic Stage; in black limestone facing the Ralphu Glacier, on the left bank of the Lissar River. Number of specimens examined, 4.

HUNGARITES, E. v. Mojs. Cf. Cephalopoden der mediterranen Triasprovinz, p. 221.

HUNGARITES NITIENSIS, E. v. Mojs.

1865. *Ammonites floridus* (Wulfen) juv., Salter, Palæontology of Niti, p. 61, Pl. 8, Fig. 1 (not Figs. 2 and 3, not Pl. 6, Fig. 1).

Through the kindness of Dr. Henry Woodward I have before me the plaster casts of the two original larger specimens figured by Salter and preserved in the British Museum in London. By a happy chance I found among the specimens collected by Dr. Diener in the Carnic Crinoid Limestone of Rimkin Paiar a small cast, which belongs to the same species as Salter's, showing the sutures, figured here of the natural size.

The slender narrowly umbilicated shell consists of high-mouthed very widely embracing whorls, with slightly inflated sides and a truncated narrow external part, which has a central keel, flat at first, then accompanied by deeply-sunk keel-furrows. The latter are bordered on the outer edge by sharp rims which viewed from the external side produce the effect of marginal keels.

The lateral sculpture consists of very faint folds which appear very fine and weak in the small specimen from Rimkin Paiar, but in Salter's specimens they are larger and more distinctly developed. They are slightly curved sigmoidally and produce knotty swellings on the outer margin which form true marginal spines in the larger of Salter's forms.

It must be recognised that the habit of the present shell reminds us above all of the young form of *Carnites floridus* (Cf. Cephal. der medit. Triasprovinz, Taf. L and LI) among all known triassic Ammonites. Whether, however, we have here a type standing in closer relation with *Carnites* (which according to the ontogenetic development of *Carnites floridus* would not be impossible) cannot be determined with the insufficient material at command.

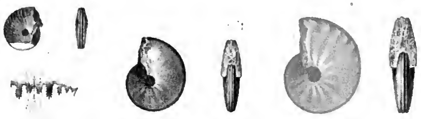

Fig 1 Fig 2. Fig. 3

Hungarites nitiensis.

Fig. 1. Chambered casts of the natural size, from the Crinoidal limestone with *Trachyceras tibeticum* from Rimkin Paiar. Sutures enlarged.

Figs. 2, 3. After drawings taken from plaster casts of Salter's original specimens from Niti Pass. Natural size.

But in any case it must be pointed out that the character of the external part as well as the development of the sutures in *Hungarites nitiensis* are distinguished from the geologically older representatives of the genus known up to the present time. The possibility must, however, be kept in view that the necessity for the erection of a new genus may arise when sufficient material has been obtained.

Sutures.—The suture-line is, in contrast to the older *Hungarites*, no more in the ceratitic stage of development, but is decidedly brachyphyll, a circumstance that deserves the more attention as even the small specimen from Rimkin Paiar which forms the subject of our illustration and description has already very highly developed sutures. Another peculiarity is the slight depth of the external lobe, which is the more striking, as the first lateral lobe is distinguished by very considerable depth. The arrangement of the sutures is normal. There are only two lateral lobes, which even in this young cast are followed by two auxiliary lobes down to the umbilical margin. Salter's drawing of the sutures which is reproduced from the larger specimen, illustrated in Fig. 2, shows four auxiliary lobes. This specimen has, it must be remarked, suffered through weathering, and the difference in Salter's drawing of the first lateral lobe, which appears to be not deep enough, is probably to be traced to this circumstance. The external lobe which reaches over the outer margins to the sides is divided into two one-pointed diverging branches by a median projection. The latter is broad rising in a blunt pyramid, provided with two lateral branches. The larger of these lateral branches coincides with the outer margins and reminds us of a similarly situated branch in *Hungarites Pradoi* (Ceph. d. med. Triasprovinz, Taf. XXXII., Fig. 7). The two lateral lobes, the second of which reaches to about the depth of the external lobe while the first is, as already mentioned, distinguished by great depth, are divided into three points by two branches rising from their base, the auxiliary lobes showing only a two-pointed division.

The saddles are very slender and provided with notches which cut very deeply into their walls. The summits of the saddles appear, it is true, with an unbroken margin, not with a sharply rounded but a somewhat irregular outline, which may be regarded as a stage preceding the notching. The external saddle and the first lateral one may have about the same height.

Dimensions.—

Diameter	30 mm.
Height of the last whorl	14·5 „
Thickness „ „	9 „
Width of the umbilicus	8 „

Locality and Geological Position.—Carnic Stage; in the Crinoidal limestone of Rimkin Paiar and in the Niti Pass. Number of specimens examined in the former locality, 1; in the latter, 2.

NAUTILEA.

A. GYROCERATIDÆ.

1. PLEURONAUTILUS, E. v. Mojs., Cf. Cephalopoden der mediterranen Triasprovinz, p. 273.

1. PLEURONAUTILUS TIBETICUS, E. v. Mojs., Pl. XXI., Fig. 3.

This shell, chambered throughout, is closely related in the form of the whorls as well as in the sculpture of the shell to *Pleuronautilus Wulfeni* (E. v. Mojsisovics, Cephalopoden der Hallstätter Kalke, I. Bd., p. 10, Taf. VII, Fig. 3) from the Julian beds of the Alps.

The shell, moderately increasing, consists of somewhat more than one and a half whorls. The umbilicus is perforated in the innermost whorl. The innermost whorl begins very bluntly, increases very quickly to a considerable thickness and height and then continues growing in both directions in a very moderate degree. This blunt embryonal part has very distinctly marked transverse striæ on the shell; these are crossed by fainter longitudinal striæ. At the beginning of the second fourth of the inner whorl, simultaneously with the development of an umbilical margin and the flattening of the sides, there occur transverse ribs, faint and following one another at rather wide intervals. Marginal tubercles, of which faint swellings still continue, rib-like, a little on the external part, are at the beginning of the outer whorl connected with the ribs now developed into folds. More anteriorly the fold-like ribs become more and more obscure on the sides, while the marginal tubercles preserve their distinct character.

The external part is flattened in its middle area. From this region, laterally rather sharply bounded, the shell becomes inflated up to the tubercles situated on the margin. This median flattening of the external part is not yet perceptible on the first half of the whorl.

The number of the marginal tubercles present in the circumference of the last whorl amounts to about 15. There is a normal line present.

Siphuncle.—The position of the siphuncle could not be ascertained.

Sutures.—The sutures rather widely separated from one another show a flat external lobe, which is separated from the flat lateral lobe by a broad saddle reaching its greatest height on the margin. The lateral lobe does not reach the depth of the external lobe. A second saddle-shaped curvature of the suture-line is present on the umbilical margin. An internal lobe could not be observed.

Dimensions.—

Diameter	43 mm.
Height of the last whorl	19 „
Thickness „ „ „	21 „
Width of the umbilicus	13 „

Locality and Geological Position.—Carnic Stage; from the lower Daonella beds (Sections 1-2) of the Bambanag Section. Number of specimens examined, 1.

Remarks upon *Pleuronautilus Pichleri*, Hau.—I find myself compelled to expressly declare here that the designation *Pleuronautilus semicostatus*, of Beyrich, must be applied to the specimen described and figured by me under this designation in the "Cephalopoden der mediterranen Triasprovinz," p. 278, Taf. LXXXVI., Figs. 1, 2; for the specimen illustrated in Fig. 2, Pl. LXXXVI., on which the description is based was the original of Beyrich's *Nautilus semicostatus*, which Beyrich described as *Nautilus Pichleri*, Hau., in the year 1867, in the Transactions of the Berlin Academy, and illustrated certainly in a somewhat schematic way (Pl. III., Fig. 4). I did not think it necessary in the description of *Pleuronautilus semicostatus* to mention specially that it was only a question of Beyrich's original to *N. semicostatus* and *N. Pichleri*, though the list of synonyms was in favour of this, and from the statement concerning the proprietorship in the explanation of the plate it was to be understood that the one of the figured specimens belonged to the Berlin Museum.

I feel compelled to make this correction because of the wrong impression which my representation of *Pleuronautilus semicostatus* has given rise to, first by Fr. v. Hauer (Cephalopoden des bosnischen Muschelkalks, Denkschr. Akad. d. Wiss., Wien, 1887, Bd. LIV., p. 15), then by Salomon in his work on the Marmolata (Palæontographica, Bd. XLII., p. 176) and finally just recently by G. v. Arthaber (Cephalopodenfauna der Reiflinger Kalke, Beiträge zur Palæontologie Oesterreich-Ungarns und des Orients, Bd. X., p. 33).

2. PLEURONAUTILUS, f. ind.

This is a fragment of a chambered whorl half of which is calcified. The specimen reminds us of *Pleuronautilus Wulfeni*, Mojs. (Ceph. d. Hallstätter Kalke,

I. Bd., p. 10, Taf. VII., Fig. 3), but it has a less height and greater breadth and wants the characteristic longitudinal striæ in an otherwise similar sculpture.

There is a flat external lobe on the broad external part. A lateral lobe is, on the other hand, scarcely indicated and not so deep as the external lobe. Whether an internal lobe is developed or not could not be observed.

The siphuncle lies at somewhat less than half the height of the whorl.

Locality and Geological Position.—Carnic Stage; in the Daonella beds of Lauka. Number of specimens examined, 1.

B. NAUTILIDÆ.

1.—NAUTILUS, auctorum.

1.—NAUTILUS BAMBANAGENSIS, E. v. Mojs., Pl. XXI., Fig. 1.

The cast provided with the body-chamber consists of three very quickly increasing whorls embracing one another, of which the two outer are higher than wide and have their greatest thickness in the vicinity of the umbilical margin. The external part is rounded. A strong callus closes the umbilicus which is somewhat open in the cast. The innermost whorl which is wider than high has no impression of the internal part, which however is already very distinct in the second whorl.

Siphuncle.—This lies very deep, at a slight distance from the internal part.

Sutures.—The very closely arranged septa describe a flat wide lobe on the sides. An accurate observation of the course of the septa on the external part is rendered difficult owing to the infilling of the chambers having been fractured. An external lobe, however, does not seem to be present, or, should this be there, it is only very slightly developed. An internal lobe is not present.

Dimensions.—

Diameter	135	mm.
Height of the last whorl	87	"
Thickness " " " about	77	"
Width of the umbilicus	0	"

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 1.

2. NAUTILUS, f. ind. ex aff. N. MESODICI, Pl. XXI., Fig. 2.

This cast chambered throughout shows a great resemblance to *Nautilus mesodicus*, Hau.[1], and has a considerably more concentrated growth. The perforation of the umbilicus, which in *Nautilus mesodicus* amounts to about 12 mm., is in the present cast only 2 mm. There are about one and a half whorls at the diameter of 48 mm. Sharp edges are not yet present at the beginning of the last whorl, but they are formed in the course of the latter. The flattening and the individualisation of the external part occurs simultaneously with the appearance of the marginal angles.

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[1] E. v. Mojsisovics, Cephalopoden der Hallstätter Kalke, I Bd., p. 21, Taf. VIII., Fig. 1.

Siphuncle.—The position of the siphuncle is very deep, near the internal part.

Sutures.—An internal lobe is not present.

The development of the flat external lobe occupying the breadth of the external part goes hand in hand with the appearance of the marginal angles. There is a broad flat lateral lobe at the sides as in *Nautilus mesodicus.* The crowded condition of the septa, which considerably increases towards the anterior fractured edge, is still remarkable. From this increasing shortness of the distance of the septa it must be concluded that the specimen was broken off near the beginning of the body-chamber.

Dimensions.—

Diameter	48	mm.
Height of the last whorl	28	„
Thickness „ „ „	28	„
Width of the umbilicus	4	„

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 1.

3. Nautilus, nov. f. ind.

From the Daonella beds of Lauka there are two crushed specimens of a *Nautilus* which reminds us by its shape and the arrangement of its sutures of *Nautilus haloricus*, Mojs. (Ceph. d. Hallst. Kalke, 1 Bd., p. 20, Taf. VII., Fig. 4), and which is especially distinguished by the fact that the external part seems to be more sharply marked off by blunt angles from the sides.

From its bad state of preservation it would be useless to go more minutely into the description of this undeterminable specimen.

2. Clydonautilus, E. v. Mojs., Cf. Cephalopoden der mediterranen Triasprovinz, p. 281.

1. Clydonautilus Griesbachi, E. v. Mojs., Pl. XXII., Fig. 1.

This species may be regarded as the precursor of *Clydonautilus biangularis*, for, when it has attained dimensions in which *Clydonautilus biangularis* has already reached its characteristic features, it is still in a stage of development which characterizes the latter in the adolescent stage.

The penultimate whorl of the figured specimen still possesses an inflated external part, which is not separated from the sides even by the indication of an angle but merges into the sides with a continuous swelling.

At the beginning of the last whorl, which is chambered throughout, there are faint rounded angles forming the boundaries of the still inflated external part. These angles are still more conspicuous up to the anterior end of this whorl.

The greater breadth of the external area and the greater thickness of the whorls may be further mentioned as distinguishing features in contrast to *Clydonautilus biangularis.* As to the form of the umbilicus, a decided opinion as to whether it was open or closed by a callus, cannot be arrived at owing to the bad state of preservation. It has however the appearance as if the umbilicus were somewhat open.

Siphuncle.—Its position seems to be the same as in *Clydonautilus biangularis.* But perfectly correct observation was unfortunately not possible.

Sutures.—The mode of development of the suture-line is about the same as in *Clydonautilus biangularis,* with the remarkable difference, however, that a division of the external lobe by a flat median projection never occurs here. Furthermore the external saddle is in *Clydonautilus Griesbachi* at the anterior end of this fragment just at the rounded marginal angle, while in shells of the same dimensions of *Clydonautilus biangularis* the external saddle is seen to be shifted to the sides.

The great width of the lateral lobe is further very noteworthy, this being due to the fact that the top of the lateral saddle is only on the umbilical margin. The penultimate whorl shows the flat sinuosity of the external lobe in the completely rounded external part which is not yet individualized. There is no internal lobe.

Dimensions.—

Diameter	86	mm.	
Height of the last whorl	54	„	(cast)
Thickness „ „ „	44	„	
Width of the umbilicus	2·5	„	(cast)

Locality and Geological Position.—Juvavian Stage; in the Limestone complex (No. 6) with *Pinacoceras* cf. *imperator* of the Bambanag Section. Number of specimens examined, 1.

2. CLYDONAUTILUS BIANGULARIS, E. v. Mojs., Pl. XXII., Figs. 2, 3.

The shell distinguished by an umbilicus closed by a callus has a narrow external part, which is not defined by lateral angles, and is completely smooth and flattened. The sides converge towards the external part. The shell reaches its greatest breadth outside the deep umbilicus, in the region of the lateral saddle. The whorls are moreover higher than wide. An umbilical margin is not present, but the shell descends in a curve from the greatest lateral inflation in the region of the lateral saddle to the umbilicus which seems to be open on the casts.

The sculpture consists of flat, more or less conspicuous folds, which on the sides undergo an anteriorly convex curvature and continue in a lessening degree over the flattened external part. Coarser fold-like striæ are also observed in some specimens parallel to these folds, especially on the upper half of the sides.

The normal line in the middle of the external part is present on the chambered portions of the shell as well as on the body-chambers of the casts.

Internal casts have a rounded external part. The two marginal angles make their appearance simultaneously with the flattening and the individualisation of the external part only at a diameter of about 16 mm.

It is worthy of note that there are several examples of body-chambers of very different dimensions in the present material. The last septa are not wide apart in these specimens, so that probably immature individuals in the different stages of growth may be present. The largest specimen is chambered throughout at a diameter of 100 mm.

Clydonautilus biangularis is very closely related to *Clydonautilus Quenstedti*, Hau., from the middle Juvavian Hallstatt Limestone, but is distinguished from this by the umbilicus being closed by a callus and by the crossing of the external part by the radial folds.

Siphuncle.—The orifice of the siphuncle, elliptically elongated in the direction of the radius, is somewhat above the middle of the distance between the external parts.

Sutures.—Besides the flatly arched lateral lobe there is on the sides in the young only an auxiliary lobe present and the septa pass uncurved over the external part. Almost simultaneously with the appearance of the external angles a gentle anteriorly concave curvature of the septum is formed on the external part which gradually changes into an external lobe increasing in depth. The external saddle thus simultaneously arising shifts gradually from the external angle to the sides and becomes finally individualised into a round pointed saddle top which is followed by the very deep rounded large lateral lobe.

The lateral saddle which separates the lateral lobe from the auxiliary lobe, falling into the umbilical suture, is broadly rounded above.

Another modification occurs in the external lobe at a more advanced stage of growth. Its centre rises into a flat undulation so that a kind of very low but broadly spread and broadly inflated median projection results, which according to the analogy of the Ammonite sutures separates the external lobe into two halves. An internal lobe is not present.

Dimensions.—

Diameter	80	mm.
Height of the last whorl	51·5	„
Breadth „ „ „	40	„
Width of the umbilicus	0	„

Locality and Geological Position.—Juvavian Stage; in the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 8.

3. Clydonautilus, nov. f. ind.

There is a fragment of a *Clydonautilus* from the Daonella beds of Lauka which is distinguished from *Clydonautilus Griesbachi*, to which it is closely allied, by the greater inflation of the external part which is bordered at the sides by blunt angles. Faint transverse folds, similar to those of *Clydonautilus biangularis*, are present on the sides.

The suture-line, of which the external lobe as well as the greater part of the deep-lateral lobe are to be seen, shows great resemblance to *Clydonautilus Griesbachi.*

C. ORTHOCERATIDÆ.

1. ORTHOCERAS, Breynius.

Orthoceras, f. ind., Pl. XXI., Fig. 5.

Representatives of the genus *Orthoceras* are extremely rare in the upper trias of the Himálaya. The few fragments present are only sufficient to determine the genus. It is out of the question to attempt to name the species. The fragment figured is a cast of a body-chamber and comes from the Halorites-Limestone of the Bambanag Section.

DIBRANCHIATA.

AULACOCERATIDÆ.

1. ATRACTITES, Gümbel.

1861. *Atractites*, Gümbel, Geogn. Beschreibung des bayerischen Alpengebirges, p. 475.
1882. *Atractites*, E. v. Mojs., Cephalopoden der mediterranen Triasprovinz, p. 299.

ATRACTITES, f. ind., Pl. XXI., Fig. 4.

Among the material available from the upper trias of the Himálaya *Atractites* is, it is true, somewhat less rare than *Orthoceras*, but nevertheless is not of frequent occurrence.

The present fragments cannot serve for the establishment of the species.

The figured phragmocone has a divergent angle of 11·5°.

The transverse section is circular. The distance between the septa amounts to somewhat less than half the diameter of the inferior septum.

The surface of the shell shows coarse but faint and indistinct transverse striæ on the ventral side, while the dorsal side appears to be completely smooth.

There are no rostra present.

Locality and Geological Position.—Juvavian Stage; in the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 10 fragments of phragmocones.

RESULTS.

The forms described in this work are grouped, on the basis of the stratigraphical data supplied by Dr. Diener, into four faunæ, to which is added, as a fifth, the fauna of the *Tropites* Limestone of Kalapani collected by Griesbach. In order to give as complete a picture as possible of each fauna the few specimens, which on account of imperfect preservation, could not be described, are catalogued in the following lists, besides the species mentioned in the text.

1. Carnic Stage.

1. The lowest division of the Tyrolese Series, in the section of Rimkin Paiar immediately succeeding the Anisic Stage, is formed by the dark grey Limestone with *Traumatocrinus*, sp. (= *Porocrinus*, v. Dittmar).[1]

The Cephalopoda-bearing dark grey limestone, designated by Griesbach as the "Horizon of *Ammonites Aon*" of the Ralphu Glacier, in the valley of the Lissar river, belongs to the same horizon.

As is seen from the identity of some of the fossils, part of the Ammonites of the Niti Pass described by Salter come from the same group of beds.

There are, on the whole, twelve forms known up to the present time from this horizon, *viz.* :—

1. *Isculites*, cf. *Heimi*, (Rimkin Paiar).
2. *Entomoceras*, nov. f. cf. *C. Plinii*, (Rimkin Paiar).
3. *Arpadites Stracheyi*, (Niti Pass).
4. „ *rimkinensis*, (Rimkin Paiar).
5. „ *lissarensis*, (Ralphu Glacier).
6. *Protrachyceras ralphuanum*, (Ralphu Glacier).
7. „ f. ind., (Ralphu Glacier).
8. *Trachyceras tibeticum*, (Rimkin Paiar).
9. „ f. ind., (Group of *duplica*, Niti Pass).
10. *Joannites* cf. *cymbiformis*, (Rimkin Paiar, Ralphu Glacier).
11. *Ptychites posthumus*, (Ralphu Glacier).
12. *Hungarites nitiensis*, (Rimkin Paiar, Niti Pass).

Having regard to the character of the rock the dark grey limestone of Tera Gadh, north of Kalapani, labelled by Griesbach "Lower Trias, bed 2," may also be included in the horizon of the Crinoidal limestone of Rimkin Paiar. The Ammonites from Tera Gadh are as follow :—

1. *Thisbites* (?) *meleagri*.
2. *Placites*, f. ind.
3. *Arcestes subbicornis*.

It must be remarked, with reference to these lists, that the products of the above localities are very meagre. It is nevertheless easy to see at a glance that we have to deal here with a Carnic fauna. On the other hand it is less easy to decide whether we may designate the fauna as Cordevolic or Julian. In favour of the Cordevolic period might be mentioned the occurrence of some ancient types, such as *Ptychites* and *Hungarites*. It might also result from the fact that the Daonella beds, succeeding the Crinoidal limestones, must decidedly be assigned to the Julian period, that the Crinoidal limestones must belong to the next lower zone of *Trachyceras Aon*.

In the Mediterranean Province the earliest known *Ptychites* come from the Fassanic lower stage and the earliest *Hungarites* from the Longobardic, and the occurrence of these two genera in the Carnic deposits of the Himálaya must therefore be regarded as a very remarkable phenomenon. The question might therefore be raised as to whether the localities may not have been confounded. Against this I may state that *Ptychites posthumus* was worked out by myself from a hand-specimen containing *Joannites* cf. *cymbiformis*, and that further *Hungarites nitiensis* was likewise lately obtained in Vienna from the Crinoidal limestone of Rimkin Paiar. The fact is therefore not to be disputed that the two forms come from the same rocks as the rest of the fauna given above, and if the character of fauna taken as a whole points to the Carnic age, we must for the Indian trias Province regard the case as proved that the genera *Ptychites* and *Hungarites* ascend in this province to the Carnic stage. Both genera are represented by forms of very small size and concentrated growth; we lay a stress upon this circumstance, because the observation already frequently made by us that concentrated[1] types of small size are to be regarded as senile moribund phenomena acquires a new confirmation. The occurrence of a *Hungarites* in a Carnic horizon seems, however, less surprising if we remember that the genus *Carnites*, descending[2] from *Hungarites* first occurs in the Julian deposits. The more developed indentation of the sutures, moreover, distinguishes *Hungorlies niticnsis* from the older species and is in harmony with the later age of this species.

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[1] Wöhrmann, Jahrb Geol. R. A. 1889, p. 190.

If we now pass on to the consideration of the rest of the fauna, we find in it a predominant number of genera which are on the whole characteristic of the Carnic stage and a smaller number which are especially so of the Julian sub-stage. To it belong the genera *Trachyceras*, *Thisbites*, *Entomoceras*, *Isculites*, *Arcestes* and *Placites*. The genus *Trachyceras* occurs in Europe for the first time in the upper region of the Longobardic stage, but only becomes an important factor in the Cordevolic fauna. The five other genera appear in Europe for the first time in the Julian deposits. But not only the agreement of the greater number of the genera but also the specific relationship of some forms speak for the Julian age of our fauna. In the first place we mention *Joannites* cf. *cymbiformis*, and *Trachyceras tibeticum*, which latter species is so closely related to *Trachyceras Austriacum* that it may be regarded as a geographical variety of it. *Isculites* cf. *Heimi* is next to be mentioned, which diverges only a little from the European type. In the rest of the genera the relationships to Julian species and even, as in *Arcestes subbicornis*, to Tuvalic, prevail likewise. *Arpadites*, on the other hand, belongs to types which are peculiar to the Indian trias Province.

If we summarize the above observations we come to the conclusion that the Crinoidal limestone of Rimkin Paiar and the limestones of Niti Pass, Ralphu Glacier and Tera Gadh, which are on a similar horizon, are to be regarded as homotaxial with the Julian stage[3] and not with the Cordevolic.

2. From the Daonella beds overlying the Crinoidal Limestone of Rimkin Paiar

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[1] An analogous case is formed by the dwarf-like Ceratites of concentrated growth which are found in the same horizon in the Julian limestone of the Salzkammergut.

Compare the ontogenetic development of *Carnites*. Cephalopoden d. medit. Trias-provnz, p. 228.

[3] Also the genus *Traumatocrinus* must be regarded as typical of the Julian stage, as it was up to the present time known in Europe only in the Cardita beds of northern Tyrol and in the Julian limestone of Hallstatt.

cephalopods have been obtained from several localities, but these unfortunately leave much to be desired with reference to their state of preservation. According to Dr. Diener's verbal communications the cephalopods are not rare in this thick mass of beds, but it is very difficult to secure them owing to their fragility. The localities in which they have been found are named in the following list. The numbers, it must be mentioned, indicate the position within this complex of beds, No. 1 marking the lowest and No. 5 the highest position.

1. *Jovites*, ind. ex aff. *J. daci*, (No. 2, Rimkin Paiar).
2. *Eutomoceras*, n. f. cf. *E. Plinii*, (No. 1, Rimkin Paiar).
3. *Anatomites bambanagensis*, (Bambanag).
4. ,, *Eugenii*, (Rimkin Paiar).
5. ,, *Caroli*, (Rimkin Paiar).
6. *Griesbachites Medleyanus.*
7. ,, *Hauui*, (Lauka, No. 4, Bambanag).
8. *Juvavites*, f. ind., (Kiangur Section).
9. *Sagenites*, n. f. ind., (No. 2. Bambanag).
10. *Styrites* f. ind., (No. 1, 2, Bambanag).
11. ,, f. ind., (No. 1, 2, Bambanag).
12. *Tibetites*, f. ind., (upper division in the Bambanag Section).
13. *Proarcestes*, n. f. ind., (Lauka, Bambanag).
14. *Cladiscites* (*Hypocladiscites*) *subaratus*, (Lauka).
15. *Paracladiscites indicus.*
16. ,, n. f. ind.
17. *Megaphyllites* ind. (Utadurrha Pass).
18. *Placites*, ind. ex. aff. *Pl. peraucti*, (Bambanag).
19. ,, *Oldhami*, (Lanka).
20. *Mojsvárites eugyrus*, (No. 5, Bambanag, Kiangur).
21. ,, (*Phylloceras*) *Ebneri*, (Lauka).
22. *Pleuronautilus tibeticus*, (No. 1, 2, Bambanag).
23. ,, ind., (Lauka).
24. *Nautilus*, n. f. ind., (Lauka).
25. *Clydonautilus*, n. f. ind., (Lauka).
26. *Orthoceras*, f. ind., (Bambanag, Utadurrha Pass).

This fauna also bears the stamp of the Julian age as shown by the genera which it contains as well as by the relationship of its species to European ones. The beds with *Lobites ellipticus* of the Feuerkogel on the Röthelstein, near Aussee, especially show a very striking similarity to this fauna. Among these similar forms I count *Anatomites*, *Griesbachites*, *Styrites*, *Cladiscites* and *Paracladiscites*, the last of which is represented by two species perhaps identical with the European ones.

Anatomites shows the closest relationship with species of the beds with *Lobites ellipticus*, and it is the same with *Styrites*. *Griesbachites* may be regarded as an Indian type which has become known in Europe only as a great rarity in the beds with *Lobites ellipticus*. The genus *Tibetites* which represents the Mediterranean genus *Cyrtopleurites* in the Indian province appears in the Daonella beds for the first time. *Cyrtopleurites* occurs correspondingly for the first time also in beds with *Lobites ellipticus*. *Mojsvárites eugyrus* which comes from the uppermost division of the Daonella beds is found in Europe not only in beds with *Lobites ellipticus* but also in the zone of *Tropites subbullatus*.

As is known, certain subdivisions are to be recognized in the Julian limestone of Hallstatt (beds with *Trachyceras austriacum*, beds with *Lobites ellipticus* and beds with *Trachyceras Aonoides*) to which I have as yet attached no chronological significance on account of their close faunal relationship.[1]

The fauna of the Daonella beds only shows the character of the composition of the fauna of the beds with *Lobites ellipticus* without any foreign elements; while the Crinoidal limestone with *Trachyceras tibeticum*, as well by its lower stratigraphical position as by the admixture of older types (*Ptychites*, *Hungarites*), seems to possess a somewhat greater age, and may be regarded as a lower division of the Julian stage homotaxial with the beds with *Trachyceras austriacum*.

3. In this place the fauna of the Tropites limestones of Kalapani might be discussed; but the limestones could not unfortunately be found again in the sections closely examined by Diener and Griesbach. The uppermost layers of the Daonella beds with *Mojsvárites eugyrus* probably correspond with the Tropites limestone, or else no sediment has been deposited at all in this region of the Himálaya during the Tuvalic period. It cannot at present be decided whether it is here a question of deficiency in our knowledge of the subject or of an absence of sediments.

The fauna, unfortunately badly preserved, consists of the following forms:—

1. Jovites, nov. f. ex. aff. *J. bosnensis*.
2. „ cf. *dacus*.
3. *Tropites kalapanicus*.
4. „ nov. f., cf. *T. acutangulus*.
5. „ nov. f. ind.
6. „ ind., cf. *T. fusobullatus*.
7. „ ind., cf. *discobullatus*.
8. *Eutomoceras*, ind., cf. *E. sandlingense*.
9. *Sagenites*, ind., cf. *S. inermis*.
10. *Trachyceras*, n. f. ind.

The crinoid-bearing red limestone of Kiogarh Range, south of Sangcha Talla, in the cliff region, from which we have four specimens of *Jovites*, probably belongs also to the horizon of the Tropites limestone of Kalapani, for the specimens of *Jovites* seem to agree with the new species, mentioned above under No. 1. I consider the Tropites limestones of Kalapani as the exact homotaxial equivalent of the Tuvalic Tropites limestones of the Mediterranean Province. There exists in both cases not only the same association of genera, but also close specific relationship, which in a better state of preservation of the specimens might perhaps have led to the identification of some forms with European species.

The genus *Trachyceras* which does not appear any more in this high horizon in the Mediterranean Province forms the only foreign element of the fauna in the Tropites limestone of Kalapani. According to the account given by J. Perrin Smith,[1] *Trachyceras* is, however, also found in the Tropites beds of California, also Tuvalic. It therefore seems that the genus *Trachyceras* which appears in Europe for the last time in the Julian deposits has withdrawn during the Tuvalic period towards the east of the Thetys and into the Pacific basin.

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[1] Cephalopoden der Hallstätter Kalke, II. Bd., p. 793.

II. JUVAVIAN STAGE.

1. A complex of nodular and slaty limestones which in the labels before me is marked No. 6, and is in Dr. Diener's report designated "Hauerites beds," succeeds the Daonella beds in the Bambanag section. With the small number and the bad state of preservation of the present cephalopoda it is difficult to find a suitable name for this division.

The small fauna consists of the following forms:—

1. *Parajuvavites*, n. f. ind. (ex. aff. *P. Jacquini*).
2. „ n. f. ind.
3. *Juvavites*, ind.
4. *Sagenites*, n. f. ind.
5. *Hauerites* (?), n. f. ind.
6. *Arcestes*, n. f. ind.
7. *Pinacoceras*, ind., (Group of *Pin. imperator*).
8. *Clydonautilus Griesbachi*.

The Juvavian type of the fauna shows itself immediately and indubitably in these few remains in spite of the great deficiency of the material. *Parajuvavites* especially plays an important part in the division of the beds that follow and are represented here by two different species; then we have *Arcestes*, comparable to the Lacic *Arcestes syngonus'*; *Pinacoceras*, which reminds us very much of *P. imperator;* and *Hauerites*, all of which give the Juvavian impress to the fauna.

I consider the suggestion that this fauna might be added to the following fauna of the Halorites limestone must be put aside for the reason that not one of the numerous species of the Halorites limestone is present. *Clydonautilus Griesbachi*, which is probably the immediate ancestor of *Clydonautilus biangularis* and therefore belongs, with this species, to the same genetic series of forms, leads to the conclusion that the fauna, of which it is a constituent part, must be older than the fauna which has its descendants as contemporaries.

The faunal guides are not sufficient for a more exact determination of the age. But from the investigation into the age of the Halorites limestone it results that the fauna of the complex of beds No. 6 might be regarded as an homotaxial equivalent of the lower division of the Lacic lower stage.

2. By far the richest among the upper triassic cephalopoda faunæ investigated

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[1] The metamorphic Series of Shasta County, California, Journ. of Geology, vol. II., p. 607. Mesozoic Changes in faunal Geography of California, Journ. of Geology, vol. III., p. 377.

is that of the Halorites limestone, of which the greater part originates in the Bambanag section. Names of localities are therefore added in the following list only where the species in question originate from other localities:—

1. *Halorites procyon.*
2. „ *Sapphonis.*
3. „ *Charaxi.*
4. „ *Phaonis.*
5. „ *Alcaei.*
6. *Parajuvavites Blanfordi.*
7. „ *laukanus,* (Lauka).
8. „ *Sternbergi.*
9. „ *Feistmanteli,* (also in Rimkin Paiar).
10. „ *Jacquini.*
11. „ *Tyndalli.*
12. „ *Renardi.*
13. „ *Ludolfi.*
14. „ *minor.*
15. „ *Brintoni.*
16. „ *Buddhaicus.*
17. „ *Stoliczkai.*
18. „ n. f. ind.
19. *Thetidites Guidonis.*
20. „ *Huxleyi.*
21. *Guembelites jandianus,* (Jandi Pass).
22. *Anatibetites Kelvini,* (also in Rimkin Paiar).
23. „ n. f. ind.
24. *Tibetites Ryalli.*
25. „ *Murchisoni.*
26. „ *Perrin-Smithi.*
27. *Paratibetites Bertrandi.*
28. „ *Geikiei.*
29. „ *Adolphi.*
30. „ *angustosellatus.*
31. „ *Tornquisti.*
32. *Helictites Atalanta.*
33. *Dittmarites Hindei.*
34. *Dionites,* ind., cf. *D. Asbolus.*
35. *Steinmannites Desiderii.*
36. „ *clionitoides.*
37. „ *Noetlingi.*
38. „ *undulatostriatus.*
39. „ *Lubbocki.*
40. *Clionites Woodwardi.*
41. „ *Salteri.*
42. „ *aberrans.*
43. „ *spinosus.*
44. „ *Hughesi.*
45. „ n. f. ind.

46. *Sirenites Richteri.*
47. „ *elegans.*
48. „ n. f. ind.
49. *Sandlingites Nicolai.*
50. „ *Archibaldi.*
51. *Arcestes Leonardi.*
52. *Pinacoceras parma.*
53. *Bambanagites Schlagintweiti.*
54. „ *Dieneri.*
55. *Placites Sakuntala.*
56. *Nautilus bambanagensis.*
57. „ n. f. ex. *aff. N. mesodici.*
58. *Clydonautilus biangularis.*
59. *Orthoceras*, f. ind.
60. *Atractites*, f. ind.

Notwithstanding the rather considerable local peculiarities, the typical Juvavian habit of this fauna is very striking, and it therefore seems to us superfluous to further discuss the distribution in the Juvavian stage. The analysis will therefore be confined exclusively to the emphasizing of the local features and the more exact determination of the age.

Halorites and *Parajuvavites*, both of which genera give to the fauna a type peculiar to it, are conspicuous for their fecundity. *Halorites* is exclusively represented by acatenate species with externally rounded peristome, while in the acatenate Mediterranean species the peristome is as a rule rectangular. Acatenate forms with externally rounded peristome are only very rarely found in the Hallstatt limestone; they may be designated as Indian elements. The new genus *Parajuvavites* is in its typical representatives confined to India. A closely agreeing form has however been known as a rarity in the Lacic Hallstatt marble of Leisling, near Goisern, but it is distinguished from its Indian congeners by having uninterrupted external ribs. The Sibirites genus *Thetidites* is confined to India. The representative genus *Metasibirites* occurs in the Lacic deposits of the Mediterranean Province. Another genus peculiar to the Indian Province is *Tibetites*, with the sub-genera *Anatibetites* and *Paratibetites*. *Tibetites* is replaced in the Mediterranean Province by the allied genus *Cyrtopleurites*. Exclusively Indian types which have no representatives in the Mediterranean Province are *Guembelites* and *Bambanagites*.

A highly interesting type is formed in the Indian Province by the group of *Steinmannites undulatostriati*, which I have recently collected in a species not yet described in the Lacic Hallstatt marble with *Sagenites Giebeli*. *Clionites*, which is as frequent in India as *Steinmannites*, comes nearest to an upper Lacic form[1] from the group of *Clionites Ares*. The genus *Dionites* is represented in our Indian fauna by a fragment which comes very near to *Dionites Asbolus* and is perhaps even identical with it.

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[1] Clionites n. f. ind. ex. aff. *Cl. Ares*, Cephalopoden der Hallstätter Kalke, II. Bd., p. 479, Taf. CXLIV, fig. 3.

The group of *Sirenites Argonautæ* is represented by two species, one of which, *viz.*, *S. Richteri*, comes very near the Lacic *S. Evæ*; while the other, *S. elegans*, recalls the Alaunic *S. Stachei*. *Sandlingites* is closely related to the upper Lacic *Sandlingites Reyeri*. *Arcestes Leonardi* comes nearest to the upper Lacic *Arcestes biceps*. The genus *Pinacoceras* is represented by the species *P. parma* occurring in the upper Lacic and the Alaunic Hallstatt limestone. *Placites Sakuntala*, an independent Indian type, seems to be related to the upper Lacic *Placites polydactylus* *Clydonautilus biangularis* reminds us of the Alaunic *Clydonautilus Quenstedti* while an unknown new *Nautilus* recalls *N. mesodicus*.

The cephalopod fauna of the Halorites limestone has, as the above analysis shows, relations with both the Alaunic and the Lacic fauna. It remains therefore to investigate whether there is an equal distribution of the fauna in both, or whether there is a preponderance of it in one of them.

The opinion might be expressed that the occurrence of the genus *Tibetites*, which represents *Cyrtopleurites*, points to the Alaunic sub-stage, as from the Lacic deposits of the Mediterranean Province *Cyrtopleurites* is not yet known, whilst the Alaunic fauna comprises most representatives of this genus. It must on the other hand be remembered that the genus *Cyrtopleurites* occurs already in typical species in the Mediterranean Province during the Julian period. The apparent intermittence during the Lacic period has therefore no great significance and may be annulled by fortunate discoveries.

The circumstance that the acatenate *Halorites* with externally rounded peristome has up to the present time been stated to occur only in the Alaunic fauna of the Mediterranean Province, can be brought forward just as little in favour of the recognition of an Alaunic age, for the rather frequent occurrence of acatenate *Halorites* in the Lacic Hallstatt limestone gives rise to the supposition that it is perhaps only a matter of chance that such Indian *Halorites* types have not also been found in the Lacic Hallstatt limestone.

The specific similarities to Alaunic species—putting aside *Pinacoceras parma*, a species known to be Lacic as well as Alaunic—are rather infrequent in the fauna of the Halorites limestone and are confined to *Sirenites elegans* and *Clydonautilus biangularis*, while a greater number of relationships and analogies speak in favour of the Lacic age.

The discovery, above mentioned, of an undulatostriate *Steinmannites* in the Lacic Hallstatt limestone is to be referred to in the first place. The occurrence of the genus *Parajuvavites*, which is confined to the Lacic stage of the Hallstatt limestone, is also of some significance; so is the limitation of the genus *Metasibirites* to the Lacic deposits. We have further to refer to the specific similarities to *Helictites Atalanta*, *Dionites* cf. *Asbolus*, *Sirenites Richteri* and *Arcestes Leonardi*, as well as to the close relationship of *Clionites* to a Lacic species of the Mediterranean Province and of *Sandlingites* to the Lacic *Sandlingites Reyeri*.

The relationship to the Lacic stage is, as can be easily seen, manifold. There is still, however, a further consideration which leads to the conclusion that the Halorites limestone is to be assigned to the Lacic stage. The Halorites limestone is wanting in all the elements which are, according to present knowledge, confined to the Alaunic stage and of which they are characteristic.

From the establishment of the Lacic age for the Halorites limestone it results that the above-mentioned complex of beds, No. 6, with *Clydonautilus Griesbachi*, underlying the Halorites limestone, is to be regarded as a lower division of the Lacic stage. As in the Mediterranean Province two closely related Lacic faunæ, the zones of *Sagenites Giebeli* and of *Cladiscites ruber*, can be distinguished, so also in the Indian Province two Lacic zones could be supposed to exist, *i.e.*, the still incompletely known lower zone of *Clydonautilus Griesbachi* and the upper zone of *Steinmannites undulatostriatus.*

3. The cephalopoda-bearing beds in the parts of the Himálaya best known up to the present time terminate with the Halorites limestone. Only from the "Sagenites beds," so named by Dr. Diener, which are separated from the Halorites limestone by the limestones and dolomites (100—120 m. thick) with *Spiriferina Griesbachi*, Bittn., there is an imperfect fragment of a *Sagenites* related to *Sagenites quinquepunctatus*. Such forms extend in the Mediterranean Province to the Sevatic stage.

Could one see in the beds with *Spiriferina Griesbachi* a deposit homotaxial with the Alaunic sub-stage, the bivalve beds, 30-40 m. thick, with *Sagenites* might already be of Sevatic age. In this case the limestone and dolomites, designated as "Dachstein Kalk" at the top of the "Sagenites beds," might well be regarded as at least partly representing the Rhætic stage, but it must not be ignored that lower Jurassic (Liassic) horizons might also be contained in them.

Break in the succession of the beds.—The following table, which extends from the overlying Liassic boundary to the underlying boundary between the Dinaric and the Scythian series, will clearly show the stratigraphical position which the cephalopoda-bearing upper triassic deposits which are more minutely dealt with in the present work occupy. It becomes clear from this table that at least according to the present state of our knowledge there seems to exist a great hiatus in the succession of deposits in the parts of the Himálaya more closely examined up to the present time, a hiatus that corresponds to the duration of the Cordevolic, Longobardic and Fassanic periods. This hiatus agrees in a remarkable manner, as Diener has already mentioned, exactly with the hiatus which seems to exist in our north-eastern Alps. Only recently it was still considered to be an established fact that in this part of the Alps the zone of *Trachyceras Aonoides* lay directly on the beds with *Ceratites trinodosus*, though there were those who supported the opinion that the Reifling limestones must represent not only the Anisic stage but also the zones (apparently wanting, and the existence of which cannot be proved on palæontological grounds) extending upwards to the *Aonoides* zone. Dr. G. v. Arthaber[1] who with great zeal and success devotes himself to the study of the typical Reifling limestone of Reifling has now actually succeeded in finding palæontological support for the recognition of the representation of the Fassanic and Longobardic faunæ in the upper part of the Reifling limestone.

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[1] Verh. geol. R. A., 1896, p. 124.

Series.	Stages.	Sub-stages.	Zones in the Mediterranean Province.	Indian Province.
BAJUVARIAN.	Rhætic	Rhætic	22. Zone of *Avicula contorta*	? Hochgebirgskalk?
	Juvavian.	Sevatic	21. Zone of *Sirenites Argonautæ*.	
			20. Zone of *Pinacoceras Metternichi*	"Sagenites beds"?
		Alaunic	19. Zone of *Cyrtopleurites bicrenatus*	Beds with *Spiriferina Griesbachi*?
		Lacic	18. Zone of *Cladiscites ruber*	Zone of *Steinmannites undulatostriatus*.
			17. Zone of *Sagenites Giebeli*	Zone of *Clydonautilus Griesbachi*.
TYROLEES	Carnic.	Tuvalic	16. Zone of *Tropites subbullatus*.	Tropites Limestone of Kalapani.
		Julian	15. Zone of *Trachyceras Aonoides*	1. Daonella beds with *Griesbachites Hanni*. 2. Crinoidal Limestone with *Trachyceras tibeticum*.
		Cordevolic	14. Zone of *Trachyceras Aon*	Break in the succession of sedimentary deposits.
	Noric.	Longobardic	13. Zone of *Protachyceras Archelaus*	
		Fassanic	12. Zone of *Dinarites avisianus*.	
			11. Zone of *Protrachyceras Curionii*	
DINARIC	Anisic.	Bosnian	10. Zone of *Ceratites trinodosus*	Zone of *Ptychites rugifer*.
		Balatonic	9. Zone of *Ceratites binodosus*	Zone of *Sibirites Prahlada*.
	Hydaspic	Hydaspic	?	8. Zone of *Stephanites superbus* (Salt Range).

Dr. A. Bittner[1] could also in a number of places in upper Steiermark and lower Austria, in the border region between the Reifling limestone and the *Halobia rugosa* slates, prove the presence of the Brachiopoda of the so-called Partnach beds, which lie in the regions of the Wendelstein and Füssen between the Anisic stage and the Wetterstein limestone, and which has been wrongly placed by a number of recent authors on the same horizon as the St. Cassian beds. Without entering here into a discussion about the probable horizon of these Partnach beds which are either directly overlaid by the *Halobia rugosa* slates or by the Wetterstein limestone, I should like to mention here as characterising the great hiatus[1] in the succession of beds, occurring in places, that in the Salzkammergut the Sevatic Zlambach beds lie in some places above the Anisic stage. In this latter case not only the two lower divisions of the Juvavian stage are wanting, but also the whole of the Tyrolese series. I should not therefore like to attach any great importance to the hiatus in the Himálayan trias section, but only see in it a repetition of a phenomenon known to Alpine geologists. The expectation may therefore be indulged in that fortunate discoveries may lead to the filling up of such a hiatus by further investigations in the Asiatic mountains.

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[1] Verh. geol. R. A., 1896, p. 18.

Also the absence of the Tropites limestones of Kalapani in the sections, so carefully studied by Griesbach and Diener, of the Shalshal cliff near Rimkin Paiar and the Bambanag cliffs in the Girthi Valley might be regarded as an argument in favour of the local nature of the hiatus, if the hiatus in question should turn out to be a real one.

The Indian Trias Province.—There is no occasion to explain further that the upper triassic faunæ of the Himálaya here described bear quite a distinct local character which distinguishes them from the homotaxial faunæ of the Mediterranean Province. Nevertheless there can be no doubt of the former existence of an open connexion of the sea between the two regions. The Mediteranean Province is the most westerly extension of the Thetys, so called by Ed. Suess, the great Trias sea, which, occupying the place of the present Asiatic mountains, extended from the Mediterranean gulf in a west-easterly direction to the great Pacific Ocean. Were the continuous connexion between the Mediterranean gulf and the Indian part of this Thetys, with its faunal contents, known to us, the contrast between the Mediterranean and Indian faunæ would probably be less abrupt and the faunæ of the middle portion for the greater part still unknown would show a gradual transition between the widely remote western and eastern regions of the Thetys, which we now designate as Mediterranean and Indian Trias Provinces.

The preponderance of *Trachyostraca* with the simultaneous diminution of *Leiostraca* is one of the most striking peculiarities of the upper triassic cephalopod faunæ of the Indian Province. We shall only refer here to the remarkable rarity and the small number of species of *Arcestes* and to the only quite isolated occurrence of the genus *Megaphyllites*. *Arcestes* and, in certain deposits, also *Cladiscites* and *Megaphyllites* play, as is known, an important part, in the Mediterranean Trias Province; but their occurrence is chiefly confined to limestone formations, poor in clay, as I mentioned years ago;[2] while also in the Mediterranean Province deposits richer in clay, as for instance, the Wengen and St. Cassian beds, show a predominance of *Trachyostraca*. It might therefore be supposed that the diminution of *Leiostraca* in the upper triassic deposits of the Himálaya may be connected with their clayey contents. This may be the case to a certain degree, especially in the Daonella beds; but it seems as if the character of the

[1] Cf. Ueber den chronologischen Umfang des Dachsteinkalkes. Sitzungsber., Bd. CV., Abth. I., p. 11.

[2] Cephalopoden der Medit. Triasprovinz, pp. 152, 312, 315.

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facies would not alone be sufficient to explain the rarity of the occurrence of *Leiostraca* in the upper trias of the Himálaya. It is particularly striking that in spite of the small number of cephalopoda from the Crinoidal limestone with *Trachyceras tibeticum* the genus *Joannites* occurs rather frequently among them.

The Halorites limestone with *Steinmannites undulatostriatus* might not essentially differ with reference to the clayey contents from the Crinoidal limestone with *Trachyceras tibeticum*; nevertheless the Leiostracan Ammonites in them are amongst the greatest rarities. It therefore seems that this phenomenon is not to be explained by the peculiarity of the facies, but by the conditions of the geographical distribution.

It is noteworthy that *Cladiscitidæ, Megaphyllites* and *Phylloceras* in the Himálaya have only been found in beds of Carnic age and seem to be wanting in the Juvavian deposits. The genus *Stenarcestes* of the family Arcestidæ has not been found in the Himálaya up to the present time; but it appears associated with *Phylloceras* from the group of *P. neojurense* in the trias of New Caledonia, from which it may be concluded that it might not have been foreign to the Thetys. The upward extension of the genera *Ptychites* and *Hungarites* into the Julian faunæ, already minutely discussed, forms a peculiarity of the Indian Province.

With reference to Trachyostraca the considerable numerical preponderance of the Dinaritidæ and Haloritidæ must be taken into account. The Tropitidæ are confined to the Carnic stage, and do not seem to be very numerous. The Tirolitidæ belong to types which occur sporadically and are therefore rare.

The Dinaritidæ belong, as was already shown[1] some time ago, to the most characteristic types of the Arctic-Pacific and the Indian Trias Provinces.

They form there with the exception of the completely wanting Tirolitidæ the only representatives of the Ceratitoidea. The new and important monographs of Waagen and Diener on the cephalopoda of the Scythian and Dinaric series have fully corroborated the validity of this classification of the Indian Province.[2] The Tirolitidæ are in accordance with our present knowledge to be regarded as specific Mediterranean types which have branched off during the Scythian period in the Mediterranean Province and have become independently developed within this Province.

Some rare representatives of Trachycerata belonging to the genetic series of Tirolitidæ appear now suddenly quite sporadically during the Carnic period in the Indian seas (Noric deposits, as mentioned above, have not yet been proved to exist in the Himálaya), and a few rare types of the same family (*Sirenites* and *Sandlingites*) also during the Lacic period surprise us. If this sporadic occurrence of a stock unknown before in the Indian seas points to a migration from distinct seas, the fact *that these rare foreign forms almost without exception indicate close*

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[1] Arktische Triasfaunen. Mém. de l'Acad. des Sciences de St. Pétersbourg. T. XXXIII, No. 6, p. 143.

[2] *Balatonites punjabiensis* from the Hydaspic stage of the Salt Range described by Waagen (Paleont. Indica, Ser. XIII, Salt Range Fossils, Vol. II, p. 64, pl. XXIV, Fig. 5) is based on a badly preserved specimen, and Waagen himself considers the determination of the genus doubtful. This specimen is in no way calculated to prove a fact of such great importance as the presence of *Balatonites* in the Indian Muschelkalk would be.

specific relationship with Mediterranean species throws a strong light upon their origin. It can therefore scarcely be doubted that the Trachycerata of the Carnic and the Juvavian stages of India are to be regarded as immigrants from the Mediterranean Province.

Among genera peculiar to the Indian Province but which in the Mediterranean Province only occur as great rarities or not at all, the following may be mentioned:—*Parajuvavites, Griesbachites, Guembelites, Tibetites, Thetidites* and *Bambanagites*. The Indian Province is, on the other hand, deficient in *Orthopleuritidæ* and *Celtitidæ*, as also in the genus *Margarites* and in the group of *Halorites catenati* which may all be assigned to the characteristic types of the Mediterranean Province. In the discussion of the age of each division of the beds attention has already been drawn to some groups characteristic of the Indian Province from genera which have also their habitat in the Mediterranean Province, *viz.*, the group of *Steinmannites undulatostriatus* and the group of *Halorites procyon*.

THE SEAS OF THE TRIASSIC PERIOD.

1. *The Thetys.* We have become acquainted with an uninterrupted period of the history of the Cephalopod faunæ of the Indian Province in the present memoir. That we can not, however, yet construct a complete and connected account of the succession of the Cephalopod faunæ of this province will be seen from the preceding observations. The older divisions of the Tyrolese series below the Julian fauna, and the younger divisions of the Bajuvarian series above the Lacic fauna are wanting. It must be left to later investigations to decide whether these divisions, wanting in the Indian Province, may yet be proved to exist by means of the Cephalopoda facies. On this point one cannot, with our knowledge of the Asiatic mountains still in its infancy, even venture on an opinion. But it was nevertheless very interesting to become acquainted with a larger division from the middle of the upper trias, and with the remarkable agreement with respect to the occurrence in succession of different genera and types, between the Mediterranean and the Indian Provinces.[1]

The Indian Trias Province forms an integral part of the Thetys, of which the Mediterranean Trias Province is to be regarded as the most westerly inlet. The best known areas of the Thetys are, according to the present state of our knowledge, as follow:—

1. The Mediterranean Province,
2. The Germanic shallow sea, and
3. The Indian Province.

The Germanic shallow sea forms a part of the Mediterranean Province and may be regarded as an estuary which was bordered by the extensive continent now sunk in the Atlantic Ocean. This triassic "Atlantis" existed probably already at the close of the Palæozoic period.[2] It reached, in the west, probably as far as the present North American continent,[1] which, as is known, possesses extensive triassic lacustrine deposits, of the character of the German Buntsandstein and Keuper in its eastern part; while pelagic deposits of the trias are only to be met with on the Pacific slopes of this continent. We shall return to this in referring to the great Arctic-Pacific Ocean of the Trias Period.

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[1] Cf. Cephalopoden der Hallstätter Kalke, II. Bd., p. 827.

[2] Suess, Antlitz der Erde. II. Bd., p. 317.

The relation which the Germanic estuary bears to the Mediterranean Trias Province has already been minutely discussed in former publications, to which we now simply refer in order to avoid repetition.[2] Only one important discovery recently made may be mentioned here, which gives a new clue to the relationship existing between the German Muschelkalk and the Mediterranean deposits. It is the discovery of *Ceratites nodosus* in Buchenstein limestone in the vicinity of Recoaro, by Dr. Al. Tornquist.[3]

The Buchenstein limestones form the lowest division of the Tyrolese series. Their equality in age with the Nodosus beds of the German Muschelkalk proves that the boundary so sharply defined in the Alps between the Dinaric and Tyrolese series lies midway in the Hauptmuschelkalk. While, namely, as Tornquist has shown, the Trochites limestones are paralleled with the zone of *Ceratites trinodosus* belonging to the Anisic stage, the Nodosus limestones belong already to thè lower part of the Fassanic sub-stage.[4]

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[1] A good ground for the supposition that such a continent existed, is also given by the plant remains which have been found in the coalfields of Eastern Virginia, and identified by Stur with the plants of the Lunz sandstein (Julian Stage). Cf. Stur, the Lunz (Lettenkohlen) flora in the older Mesozoic beds of the coalfields of Eastern Virginia. Verh. Geol. R. A., 1888, p. 203.

[2] Dolomitriffe von Südtirol und Venetien, pp. 39-41, ferner E. v. Mojsisovics, W. Waagen und C. Diener, Entwurf einer Gliederung der pelagischen Sedimente des Trias Systems. Sitzungsber. der mathem. naturw. Cl. Bd. CIV, Abth. 1, p. 1273.

[3] Nachrichten der. K. Gesellschaft der Wissenschaften zu Göttingen, Mathem. naturw. Classe, 1896, 1. Heft pp. 5, *et seq.*

[4] Tornquist's discovery stimulates a discussion upon the upper boundary of the German Muschelkalk. It is known that the Lettenkohle is still referred to the upper Muschelkalk by distinguished German trias investigators. Benecke has only recently likewise agreed in his well known memoir upon the division of the upper Alpine Trias and upon Alpine Muschelkalk and Muschelkalk outside the region of the Alps (Ber. d. Naturforschenden Gesellschaft zu Freiburg i. B. Bd. IX, p. 221) with the opinion that the Lettenkohle must on account of its fauna be included in the Muschelkalk. From a palæontological point of view it seems scarcely possible to doubt this, for the Molluscan fauna, up to the Grenz Dolomite inclusive, is the same as in the Muschelkalk. From the Grenz dolomite of Thuringia two cephalopods have been known, *viz.*, *Ceratities Schmidi*, Zimmermann (Zeitschr. Deutsch. Geol. Ges. 1853, p. 382) and *Trematodiscus jugatonodosus*, Zimmermann (Jahrb. d. Konigl. preuss. geolog. Landesanstalt, 1889, p. 322) and it seems advisable to inquire whether the above question could not be answered by these discoveries.

With reference to *Ceratites Schmidi* it may be permissible to recall the observations which I published in the year 1883 on the occasion of the discovery of this Ammonite (N. Jahrb. f. Min. etc., 1884, I Bd., p. 78). I then said that, starting from the supposition of an almost parallel development and of the occurrence of representative forms in the Mediterranean region and in the Germanic basin, the Grenz dolomite should be placed parallel with the Buchenstein beds. But, at the same time, I emphasized the difficulties of such a distinct parallelism. Now when the proof is forthcoming that *Ceratites nodosus* occurs in the horizon of the Buchenstein beds, the justification of the opinion then expressed may be regarded as upheld, if the Lettenkohle be included in the upper Muschelkalk, or one could assume, taking into account the somewhat higher position of *C. Schmidi*, that the Grenz dolomite is of about the same age as the Marmolata limestone.

Trematodiscus jugatonodosus shows relationship with *Trematodiscus Klipsteini* from the St. Cassian beds, as Zimmermann has already recognised. But as Nautili are, on account of their rarity and slight variability, less suitable for exact determination of the horizons of neighbouring faunæ than Ammonites, the conclusion would be somewhat risky that the Grenz dolomite should be placed in the same horizon as the St. Cassian beds.

Out of the wide expanse between the Mediterranean and the Indian Provinces there are as yet only a few places known in which triassic fossils can be assigned to definite horizons. Two places may be mentioned in Asia Minor, one of which is to be assigned to the Juvavian stage, the other to the Dinaric series. The Juvavian specimens, which may perhaps represent the Sevatic sub-stage, come from Balia-Maaden in Mysia.[1] This fauna is too incompletely known for anything to be said about its local character. But the frequency of occurrence of the genus *Arcestes* might be noted as a Mediterranean feature of the fauna. The Dinaric fauna discovered by F. Toula in the Gulf of Ismid (Sea of Marmora) admits neither of a sharper marking off into horizons, nor does it show a distinct local character. A remarkable negative feature is the rarity of *Ptychites*. It is also worthy of note that in spite of the short distance from the still typically Mediterranean Dinaric deposits of Bosnia, so little relationship can be recognised to the Dinaric faunæ of the Mediterranean Province. Under these circumstances the more distinct definition of the horizon remains an open question.

Indications of the Scythian series have been obtained from the Araxes Pass near Djoulfa in Armenia, and it would be desirable if further investigations were undertaken in this place.[2]

Didymites afghanicus, described in this memoir, forms quite an isolated discovery. The specimen was collected by Griesbach in a loose block at the Mazarghan river (Zhob valley) and its locality has not yet been discovered.

As the genus *Didymites* is confined to the Alaunic fauna the supposition may be entertained that this horizon is represented in Baluchistan, but it has not as yet been recognised from any other region in Asia.

Of great interest also are the trias fossils of Eastern Pamir,[3] collected by F. Stoliczka and described by Ed. Suess, among which are three species of *Halorella* (among them being two species which agree with Mediterranean forms) and the true *Monotis salinaria*, so often incorrectly cited. *Halorella* as well as *Monotis salinaria* occur in the Mediterranean Province in the Alaunic and the Sevatic beds, so that it may be assumed that the specimens also found in Pamir may be referred either to the middle or the upper division of the Juvavian stage. It must be specially mentioned that neither *Halorella* nor *Monotis salinaria* has so far been known from the Himálaya. The type of *Monotis salinaria* seems to be characteristic of the Thetys. It is found, according to Rothpletz, in Rotti in the Indian Archipe-

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I am therefore of opinion that further fortunate discoveries must be awaited before we are able to give a well-grounded judgment on the relationships of the Grenz dolomite to Alpine Horizons.

However this decision may result, it seems to me that something should be said about the parallelism between the Lunz sandstone and the Lettenkohle which has recently been brought again into the foreground, were it only for the purpose of expressing approval of Benecke's very appropriate remarks on this theme. Whether the Grenz dolomite is parallel with the Fassanic or, going to the utmost limits of possibility, with the Cordevolic formations, the Lunz sandstone should always be considered as belonging to the beds overlying, the equivalent of the Grenz dolomite. The correlation, always doubted by me, of the Lunz sandstone with the Lettenkohle, would therefore be negatived and all further conclusions from various sources, which have been come to on this subject, would fall through.

[1] E. v. Mojeisovics, Ueber der chronologischen Umfang des Dachsteinkalkes. Sitzungsber. d. mathem. naturw. Cl. Bd. CV., Abth. 1, p. 39.

[2] E. v. Mojsisovics, Verh. Geol. R.A., 1879, p. 171.

[3] Denkschriften, d. kais. Akad. d. Wiss. math.-naturw. Cl. Bd. LXI, pp. 458, *et seq.*

lago. The series of forms of *Pseudomonotis ochotica* replaces the type of *Monotis salinaria* in the region of the Arctic-Pacific Trias Province.

In the south of India the Thetys is bordered by extensive continental formations of the trias belonging to the old Gondwana land.[1] The trias of the Salt Range which has become known through W. Waagen's comprehensive investigations contains the most complete series of Scythian deposits. It is succeeded by the Hydaspic stage, already classed in the Dinaric stage as its lowest member, with which the triassic beds of the Salt Range, rich in fossils, terminate. From the yellow limestone lying at the base of the "variegated series" (Rhætic-Jurassic) Waagen only describes one form belonging to the Tropitidæ under the name of *Pseudharpoceras spiniger*[2] which reminds us somewhat of *Paratropites Phoebus* from the Tuvalic deposits of the Mediterranean Province. But this peculiar fossil does not suffice to base any well-founded supposition about the horizon to which it belongs. Taken as a whole the trias of the Salt Range appears in the middle and upper members as a development poor in fossils which, by reason of its geographical position between the Gondwana land in the south and the Pelagic triassic deposits of the high mountains in the north, seems to take a middle position analogous to that of the Germanic Trias between the continent of Atlantis and the trias of the Alps.

From the trias of Rotti only *Halobia* and *Daonella* have been known, besides *Monotis salinaria* already mentioned. Rothpletz who has described them[3] says that *Monotis* probably comes from a horizon different from that of *Halobia* and *Daonella*, as it has never been observed with them in the same pieces of rock. It must also be remarked that in the Hallstatt limestone the gregariously appearing *Monotis* always fills the rocks by itself and never occurs associated with *Halobia* and *Daonella*.

In favour of the view that *Monotis* from Rotti occurs in a horizon other than that of *Halobia* and *Daonella* it may however be mentioned that it comes from a locality in which it was found alone. *Monotis salinaria* is, as stated above, characteristic of the Alaunic and Sevatic faunæ. Much more difficult is the question as to the age of *Daonella* and *Halobia*, in which Rothpletz would recognise, besides *Daonella Lommeli* characteristic of the Longobardic horizon, still several other species, partly Carnic, partly Juvavian of the Mediterranean Province, but all of which, in Rotti, belong to one and the same horizon. In the great difficulty of distinguishing the species, often very similar to one another, of the two genera, I do not wish to attach too great a weight to the determination of the species. The association of *Halobia* and *Daonella*, as it occurs in Rotti,[4] is found in the

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[1] Suess, Antlitz der Erde, II. Bd., p. 318.

[2] Palæontologia Indica, Ser. XIII, Salt Range Fossils, Vol. II, P. 131, Pl. XXI, Fig. 1.

[3] Palæontographica, XXXIX, Bd., p. 89.

[4] The genera *Posidonomya*, *Daonella* and *Halobia* form a phyletic series. *Daonella* appears for the first time in the Anisic stage and *Halobia* in the Cordevolic period and reaches the highest point of its development in the Juvavian stage. The distinction of the typical forms is without difficulty. The genus *Daonella* forms the transition between *Posidonomya* and *Halobia*. If Rothpletz thinks that on account of the close relationship between *Daonella* and *Halobia* it is superfluous to distinguish *Daonella*, we cannot share this opinion. On the contrary we think that the distinction of the two genera is also desirable from a stratigraphical point of view.

Hallstatt limestone in Julian beds. But I should not from this circumstance alone like to draw the conclusion that *Halobia* and *Daonella* from Rotti must be Julian.

II. *The Region of the Arctic-Pacific Sea.* It is not improbable that the vast region, which in the year 1886[1] I comprised as the Arctic-Pacific Trias Province, may be divided into several smaller faunal districts. But this is not yet possible and the results of the detailed palæontological investigation, especially that of Californian trias, must be waited for, before we can move a step farther in this direction.

One of the most obscure points in the knowledge of the Pacific trias was the uncertainty about the position of the so widely spread beds with *Pseudomonotis ochotica*. The reason of this difficulty lay in the fact that the *Pseudomonotis* beds had up to this time been nowhere found in undoubted stratigraphical connection with other trias beds whose horizon was sufficiently well defined, and that in them no trias fossils had been known which could be referred to a definite horizon. It appears therefore of great importance to inquire whether the Californian *Monotis subcircularis* really belongs to *Pseudomonotis*, as Teller supposed, in which case it would fall into the series of forms of *Pseudomonotis ochotica*. Dr. Alpheus Hyatt had the kindness to communicate the reply to my request to the effect that he had undertaken a careful investigation into the subject, which places the reference of *M. subcircularis* to *Pseudomonotis* beyond all doubt. Upon this statement it seems now certain that the beds with *Pseudomonotis ochotica* actually belong, as was formerly assumed, to the upper division of the trias.

According to the data which Hyatt has published[2] on the trias of Taylorville in California and which will be discussed further on, *Pseudomonotis subcircularis* belongs to the Juvavian stage. *Pseudomonotis ochotica* is so closely related to *Pseudomonotis subcircularis* that Teller raised the question as to whether the two forms might not be identical. We shall therefore not make a great mistake if we assume that the beds with *Pseudomonotis ochotica*, which are now known from Siberia (Werchojansk on the Jana, and Mamga Bay in the Gulf of Okhotsk), Japan, New Caledonia, New Zealand and Australia (Nowra, New South Wales)—to indicate the distribution on the west coast of the Pacific Ocean—are likewise to be referred to the Juvavian stage.

It is not in contradiction of this assumption that Nautili of Juvavian habit had long ago been already cited[3] from New Zealand. It must also be remembered that I was lately in a position to determine from New Caledonia a *Phylloceras* of the group of *Ph. neojurense*[4] besides *Stenarcestes* described in the present memoir (cf. p. 96 above). It is true that there are no indications in this case about the locality and the relationship to the beds with *Pseudomonotis ochotica*; but it is nevertheless of interest to know that besides *Pseudomonotis* yet other fossils are now known which must also be referred to the Juvavian stage.

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[1] Arktische Triasfaunen. Mém. de l'Acad. des sc. de St. Pétersbourg, VIIe série, t. XXXIII, No. 6.

[2] Bull. Geol. Soc. of America, Vol. III, p. 397.

[3] Cf Arktische Triasfaunen, p. 151.

[4] Comptes rendus des sciences de l'Academie des sciences. Paris, 18th Novembre, 1895.

In Japan five different occurrences of the trias are known,[1] *viz.*:—

1. The Ammonite-Slates of Inai (North Japan, Province of Rikusen).
2. The beds with *Pseudomonotis ochotica*, from the same region.
3. Pseudomonotis Limestones from the Sakawa basin (Shikoku, South Japan).
4. Daonella beds from the same region.
5. The impression of an ammonite, probably from the vicinity of Sakawa.

The Ammonite fauna of North Japan is distinguished by its close relationship to Californian forms, described by Meek and Gabb. It is of special interest for us as it affords the means of separating a number of forms from the species of the Star-Peak group of Nevada belonging as they are known to do to different horizons. These forms belong in all probability to the same horizon as the Japan fauna. I have referred this fauna in my work of 1888 to the Norio stage, and I still adhere to this determination. There are only a few genera represented, *viz.*:—*Ceratites*, *Arpadites*, *Danubites*, *Japonites* *Anolcites* and *Gymnites*, the greater number of which are also found in the Anisic stage. But there are also, on the other hand, types represented which have never been found before in the Anisic deposits, such as *Arpadites*, while *Anolcites*,[2] a member of the developmental series of Tirolitidae, could not be shown to be present either in the Anisic deposits of the Indian Province or in the deposits of the Arktis of the same age. *Anolcites* occurs in the Mediterranean Province for the first time in the Bosnian horizon and extends upwards into the Julian deposits. But *Anolcites* attains its chief development in the Noric stage of the Mediterranean Province. Only *Japonites* has been found among the rest of the genera in the Bosnian beds of the Indian Trias Province; it therefore forms the only type (not including those of Japan) which has only been found in the Anisic stage. But *Japonites* cannot on account of this circumstance be considered as a genus exclusively characteristic of the Anisic stage; for the information gathered respecting the vertical distribution of this rare genus is still much too meagre, and the simultaneous occurrence with *Arpadites* and *Anolcites* in the Japanese Ammonite limestones lends colour to the supposition that *Japonites* might also occur in higher horizons. The genus *Danubites*, to which the Ammonite described by me as *Ceratites Naumanni* belongs, has likewise not been proved to exist in Noric deposits, in the Mediterranean Province, while the genus *Buchites*, probably phyletically connected with *Danubites* is found in the Carnic as well as in the Juvavian deposits of the Mediterranean Province. It cannot therefore appear remarkable if *Danubites* has also been proved to exist in Noric deposits. The genera *Ceratites* and *Gymnites* extend, as is well known, up to the Julian period, but it must be mentioned that the later Ceratites are therefore reduced, dwarfed forms. On the other hand the Japanese Ceratites may, according to their dimensions and the stage of their development, be referred to the Ceratites of the Anisic and the Fassanic faunæ, to which latter (the Fassanic one) I should like to assign the small Japanese fauna in question.

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[1] E. v. Mojsisovics. Ueber einige japanische Triasfossilien. Beitr. zur Palæontologie, von Mojsisovics und Neumayr, Bd. VII, p. 163.

[2] To this genus I now refer the Californian species *An. americanus* (= *Whitneyi*, Gabb, pro parte, Palaeontology of California, Vol. I, Pl. IV, Fig. 12, not *Fig.* 11, which is to be regarded as *Arpadites Whitneyi*) and the closely related Japanese species *Anolcites Gottschei*.

The similarity in the character of the sculpture to the Juvavian species *Clionites Ares* is probably only to be looked upon as a phenomenon of convergent development.

As to the southern Japanese deposits of the trias, they seem to belong wholly to the Juvavian stage, for the beds with *Pseudomonotis ochotica*, which according to Naumann also occur in North Japan, are referable to this stage. The Daonella beds might also belong to the same period, as *Pseudomonotis ochotica* was also found therein. The impression finally of the Ammonite from Sakawa (*C. sakawanus*) which reminds us[1] in its habit of the Mediterranean genus *Cyrtopleurites* might be assigned to the genus *Tibetites*, representing this genus in India, or, to any closely related group. The Juvavian stage is therefore also in all probability indicated by this Ammonite.

Dinaric and Scythian deposits are only found beyond the Sea of Japan in the coast province of Eastern Siberia near Wladiwostok, in the southern Ussuri region and on the island of Russkij. The working out by Diener[2] of the interesting Cephalopod faunæ of this district made us acquainted with a fauna of the Brahmanic stage, tolerably rich in species, and with a still very meagre fauna of the Anisic stage. These discoveries occur at the most southerly point known up to the present time at which on the western side of the Pacific Ocean lower triassic deposits could be proved to exist.

On the eastern side of this large sea basin Scythian deposits have yet been determined only in Idaho, some distance from the coast and on the eastern slopes of the great Cordilleras as heteromesic intercalations at the base of the development of the red sandstone formation inland. In the great chain of mountains with pelagic development of the trias, bordering the Pacific Ocean, Scythian deposits are, so far as our present knowledge goes, wanting. Whether Dinaric deposits exist is still an open question. Upper triassic deposits are, on the other hand, distributed from Canada in the north to Peru in the south. Without wishing to attach too great an importance to the present statements which are certainly still very disconnected and imperfect, this restriction of the lower triassic formations to the Arctic regions, in which they can[3] be proved to exist with rich faunæ in the lower course of the Olenek and in some neighbouring islands of the Polar Sea as well as in Spitzbergen, deserves nevertheless to be noted. If this peculiar distribution should be confirmed by further investigation, one might surmise that the formation of the great Pacific basin took place only at the time of the upper trias. The greatest horizontal distribution is possessed by the Juvavian deposits with *Pseudomonotis ochotica* which show themselves in the coast regions of the great old Ocean, according to Teller, from Werchojansk in Siberia and from Alaska in the North to New Zealand and Peru in the South, connecting the Arktis with the Pacific basin.

Passing on to the discussion of the pelagic trias deposits in the Cordilleras of

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[1] Compare, for instance, *Cyrtopleurites Hutteri.*

[2] Mémoire du comité géologique de St. Petersbourg, Vol. XIV, No. 3.

[3] E. v. Mojsisovics, Arktische Triasfaunen. Mém. de l'Acad, des Sciences de St. Pétersbourg, VII. Sèrie. t. XXXIII, No. 6 ; Ueber einige arktische Triasammoniten des nördlichen Sibiriens, l. c., t. XXXVI, No. 5.

North America, it seems advisable to start from the data obtained from Alpheus Hyatt's and Perrin Smith's recent work in California. A favourable chance procured me the opportunity of discussing personally with Prof. Hyatt the distribution and interpretation of the triassic formations of California and Nevada, and among others I owe to Mr. Hyatt the valuable and interesting communication already mentioned, that a minute examination of *Monotis subcircularis* has shown him that this species really belongs to *Pseudomonotis* and may therefore be placed in the varietal series of *Pseudomonotis ochotica*.

In the neighbourhood of Taylorville Hyatt[1] observed on two hills having a parallel strike and evidently separated from one another by a fault the details of the divisions of the so-called Swearing slates and the Hosselkus limestone.

The stratigraphically older group of beds is evidently the Hosselkus limestone which lies here immediately upon deposits of carboniferous age. Its base is formed by the Halobia beds, slaty beds with a fossil-form similar to *Halobia superba*. The latter is a characteristic form of the Tuvalic limestones of the Salzkammergut. In an intercalated calcareous band of the slate a *Tropites* similar to *Tropites subbullatus*, with an *Arcestes* and an *Atractites*, was found. The typical Hosselkus limestone lying upon this slate contains, according to Hyatt's account, besides *Tropites* and *Atractites*, yet other species of the genera *Cladiscites*, *Arcestes* (of the groups of Galeati, Bicarinati and Sublabiati), *Badiotites* and *Juvavites*.[2] The frequency of *Arcestes* as pointed out by Hyatt is remarkable. The Hosselkus limestone was proved later still by Perrin Smith to be present on the mountain ridge between Squaw Creek and Pitt River with a great abundance of fossils, to which discoveries we shall refer later on. On the ridge which was investigated by Hyatt and which, on account of the occurrence of carboniferous deposits below the trias, obtained the designation of "Carboniferous Spur," the Hosselkus limestone forms the latest member at the summit of the hill.

The "Swearing Slates" which, as mentioned above, occur on a hill having a strike parallel to that of the Hosselkus limestone, reach likewise to the summit of the ridge. The beds underlying them are concealed by debris and therefore not observable. The lowest layer accessible forms the "Monotis bed," which is full of *Pseudomonotis subcircularis*. More rarely there appear in this layer:—

Pecten deformis, Gabb.
Hemientolium daytonensis, Gabb.
Modiola triquetraeformis, Hyatt.

The next layer is the Daonella bed, with the following fauna:—

Pseudomonotis subcircularis.
Daonella tenuistriata, Hyatt.
Hemientolium daytonensis, Hyatt.

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[1] Bull. Geol. Soc. of America. Vol. III, p. 397.

[2] As these determinations were made before the appearance of the second volume of the Hallstatt Cephalopoda, the supposition may be entertained that the form which Hyatt determined as a finely ribbed *Acrochordiceras* belongs to *Miltites* or *Juvavites*. The form compared with *Balatonites Waageni* may perhaps belong to *Thisbites* or *Eutomoceras*.

Modiola triquetraeformis, Hyatt.
Avicula mucronata, Gabb.
Inoceramus gervilloides, Hyatt.
Pecten inexpectans, Hyatt.
Lima acuta, Hyatt.

Besides the species which have become more rare of the "Monotis bed," the Daonella bed contains *Daonella tenuistriata* in addition to some other Pelecypoda.

Most of these bivalve shells, *Pseudomonotis subcircularis* included, extend also into the limestone overlying the Daonella beds which has been designated the "Rhabdoceras bed." Here appear also several Cephalopoda, *viz.*:—

Arcestes californiensis, Hyatt.
Halorites americanus, Hyatt.
Halorites Ramsaueri, Gabb (non Quenstedt).
Rhabdoceras Russelli, Hyatt.
Atractites, sp.

Arcestes also occurs frequently in this small fauna.

There can be no doubt that this complex of beds of the Swearing slates is of Juvavian age. Hyatt had correctly recognised the relationship to the homotaxial deposits of the Mediterranean Province, and had, in agreement with my former view of the case, placed these beds in the Noric in a lower horizon than the Carnic Hosselkus limestone. But as this latter, as already mentioned, overlies carboniferous beds, there can be no doubt that it forms the lower member of the triassic deposits of Taylorville. The occurrence of *Halorites* and *Rhabdoceras* is conclusive proof of the Juvavian age of the Swearing slates. The presence of a catenate *Halorites* (*H. Ramsaueri*, Gabb) is of interest. The division of catenate *Halorites*, a fact already emphasized, is wanting in the lower Juvavian deposits of the Himálaya, while acatenate *Halorites* are frequent. As the connection between the Mediterranean Province and the Pacific basin can only have been made by means of the Thetys, the thought occurs to one that the emigration of the catenate *Halorites* to the Pacific basin may have taken place only in the middle or upper Juvavian period. The genus *Rhabdoceras* is also wanting in the Lacic deposits of the Indian Province, whilst it occurs in the Mediterranean Province, like the catenate *Halorites*, already in the Lacic deposits. *Pseudomonotis subcircularis* belonging to the varietal series of *P. ochotica* is unquestionably to be reckoned among the most characteristic fossils of these Swearing slates, and from the above remarks on the age of the Swearing slates it results that these mollusca, so characteristic of the Arctic-Pacific trias basin, belong to the middle or upper Juvavian stage. It is a strange coincidence that *Monotis salinaria* of the Mediterranean trias, in outline and sculpture so strikingly similar to *Pseudomonotis subcircularis*, has likewise its habitat only in the Alaunic and Sevatic deposits of the Juvavian stage. The question of a phyletic connection of both forms naturally suggests itself, but we will content ourselves with this surmise and leave the question of the possibility of the derivation of *Monotis* from *Pseudomonotis* to a future time.

The papers[1] published by Perrin Smith on Shasta county form in many respects a valuable supplement to Hyatt's sections of Taylorville (Plumas county). Shasta county is wanting in the complex of beds with Juvavian fauna designated by Hyatt as "Swearing slates." The highest member of the trias of Shasta county is formed by the Hosselkus limestone, which again has several subdivisions. The two lower subdivisions are rich in Cephalopoda. A faunally important distinction between the lowest division—the Trachyceras beds, and the succeeding series—the Atractites beds, does not seem to exist. The uppermost group—the Spiriferina beds—contains only a few remnants, not yet determined, of Brachiopoda and Pelecypoda. According to the preliminary lists of Cephalopoda published by Perrin Smith the fauna may be compared with the Tuvalic fauna of the Mediterranean Province. I can but confirm this view of its relationship on the evidence of some Cephalopoda (especially *Tropites* and *Paratropites*) kindly sent me by Professor Perrin Smith. All the types characteristic of the Tuvalic fauna are here repeated in the same association in a surprising manner. The Californian species are extremely closely related to the Mediterranean species of this horizon; some may prove upon a closer examination even identical with them. I will not enter more minutely into a discussion of the lists of fossils, as a thorough palæontological investigation of these faunæ by Messrs. Hyatt and Perrin Smith is shortly expected; I must, however, allude to the striking fact that in California, especially in the lower division of the Hosselkus limestone (the so-called Trachyceras beds) a greater number of Trachycerata occurs with the otherwise typically Tuvalic fauna. One might therefore suppose that here there was a transition fauna, composed of Julian and Tuvalic elements, somewhat similar to the fauna of the beds with *Lobites ellipticus* in the region of Aussee. But this latter is decidedly to be considered a Julian fauna, in which a few Tuvalic species and types occur for the first time. The Californian fauna must, however, from the nature of its composition be regarded as a Tuvalic one, in which, in contrast to the Mediterranean Province and in agreement with the Indian Province, the genus *Trachyceras* still survives. In the Mediterranean Province *Trachyceras* appears for the first time in the Julian fauna, while the genus ascends in India as well as in California still into the Tuvalic fauna.

The Hosselkus limestone forms in Shasta county the upper member of the so-called "Cedar Formation," while the complex of slates termed Swearing slates by Perrin Smith represents the lower member. These slates are however distinguished by its fauna as well as by its stratigraphical position from the Swearing slates of Taylorville which, according to Professor Hyatt's oral communication, are to be regarded as the type. These latter belong, as already mentioned, to the Juvavian stage, while the slates of the "Cedar Formation" should be assigned to a lower horizon.

The upper division of these slates which precedes immediately the Hosselkus limestone seems to me to correspond completely to the Halobia bed occurring in the same position near Taylorville, for it also contains *Halobia superba* and some Carnic Cephalopoda types, such as *Polycyclus*, *Eutomoceras* and *Trachyceras*.

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[1] The Metamorphic Series of Shasta County, California. Journal of Geology, Vol. II, No. 6, pp. 602-909. Mesozoic changes in the faunal Geography of California. Journal of Geology, Vol. III, No. 4, pp. 374-377.

The lower division of the same slates is formed by the "Trachyceras Homfrayi beds" which contain numerous remnants of this species, recalling in the character of the sculpture *Anasirenites tripunctatus* from the Julian limestones of the Salzkammergut. I am not in a position, being guided only by Gabb's illustration in the Palæontology of California, to decide whether there is here actually an *Anasirenites* present. The confirmation of its existence would be of chronological interest, for the oldest representatives of the genus *Anasirenites* occurs in the Mediterranean Province only in the Julian beds. Besides these Ammonites there occur, according to Perrin Smith, in the Homfrayi beds, *Halobia superba* and *Halobia rugosa* as well as rare specimens of *Pseudomonotis* related to *P. subcircularis*. It would be of interest to verify this determination anew, as, according to Hyatt's careful account, the Juvavian Swearing slates form the true horizon of *Pseudomonotis subcircularis*.

The "Cedar Formation" (to which belong the groups of beds just mentioned and assigned to the Carnic stage) is, according to Perrin Smith, underlaid in Shasta county by the Pitt Formation, an Isopic system, about 3000 feet thick, of highly siliceous and calcareous slates, conglomerates and tuffs, the upper thicker half of which belongs to the trias, while the lower part contains carboniferous fossils. The triassic portion of these beds is unfortunately very poor in fossils. There are a few Ammonites, Brachiopoda and bivalve shells, mostly very badly preserved, about 1,500 feet below the Homfrayi beds. Perrin Smith makes mention, among the Ammonites, of *Trachyceras Whitneyi*, Gabb, a species which has also been found in the Star-Peak Group of Nevada. The determination of this species, to which Gabb has evidently given too wide a scope, offers some difficulty which without obtaining the specimens in question cannot be solved solely from Gabb and Meek's descriptions and illustrations. Gabb figured as *Ammonites Whitneyi* two specimens which have nothing in common but the interruption of the sculpture on the external part. Having regard to their external appearance these two specimens might belong to two different genera, *viz.*, *Arpadites* (*Clionites*) and *Trachyceras* (*Anolcites*). It is however not impossible that the two species may belong to one and the same genus (*Anolcites*), but only a renewed examination of the original specimens and particularly the observation of the inner whorls could lead to a satisfactory conclusion. The type which I have designated *Trachyceras americanum*[1] would be placed in the subgenus *Anolcites*, to judge by Meek's illustration.

I consider the division of the trias of North America which contains these two species to be Noric and come now to the consideration of the Cephalopoda from the trias of California and Nevada described by Gabb[2] and Meek.[3]

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[1] The name of the species *Whitneyi* must be retained for Fig. 11, Pl. IV of Gabb, Palæontology of California, while I have proposed the designation *Trach. americanum* for Fig. 12 of the same plate. Arktische Triasfaunen, p. 149.

[2] Palæontology of California, Vol. I.

[3] U. S. Geological Exploration of the fortieth Parallel by Clarence King, Vol. IV., Part 1 by F. B. Meek.

As according to the valuable observations of Hyatt and Perrin Smith there can now be no doubt as to the fact that in the pelagic trias of North America a series of horizons exists varying in age, the Star-Peak Group of Nevada can also no more be regarded as a uniform complex. It may rather be assumed with tolerable certainty that the Star-Peak Group comprises the whole of the Tyrolese series, and Professor Hyatt personally informed me that the fossils described in the publications of Gabb and Meek are not the result of systematic investigation of certain beds, but of specimens casually gathered together from a mountain range which has been subjected to much crumpling and dislocation.[1]

As presumably Carnic species of the Star-Peak Group the following might be mentioned:—

Ammonites Homfrai, Gabb.
Mojsvarites (*Monophyllites*) *Billingsianus*, Gabb.[2]
Eutomoceras Laubei, Meek.

As forms, not yet placed in definite horizons, might be named:—

Sageceras Gabbi, Mojs. (Ceph. der Hallst. K., 1. Bd., p. 71).
Arcestes (*Proarcestes ?*) *Gabbi*, Meek.
(?) *Joannites* ind. (=*Ammonites Ausseeanus*, Gabb).[3]
Eudiscoceras Gabbi, Meek.

After withdrawing these species there remain the following:—

Arpadites (*Clionites ?*) *Whitneyi*, Gabb, sp.
Anolcites americanus, Mojs.
Ceratites Blakei, Gabb.
" *Meeki*, Mojs.
" *nevadanus*, Mojs.
Acrochordiceras Hyatti, Meek.
Danubites Halli, Mojs. (=*Clydonites laevidorsatus*, Meek).
Anolcites Alphei, Mojs. (=*Trach. judicaricum*, Meek).
Protrachyceras subasperum (=*Trach. judicaricum* var. *subasperum*, Meek).

Of these forms only *Acrochordiceras Hyatti*, in accordance with the experience gained from the study of fossils of other localities, points to a lower horizon, namely, the Dinaric series, and it might be possible that in the Star-Peak Range Dinaric deposits also exist from which the above-named *Acrochordiceras* originates.

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[1] That Hyatt (Bull. Geol. Soc. of America, Vol. III., p. 400) as well as Perrin Smith should assert that I had placed the Star-Peak Group in the Muschelkalk rests upon a misunderstanding which is inexplicable to me. Hyatt unfortunately does not quote any authority in support of this statement. Perrin Smith cites (Journal of Geology, Vol. II, No. 6, p. 603) my diagnosis of the genus *Acrochordiceras*, in which it is pointed out that this genus has only been found up to the present time in the Mediterranean Province in the Muschelkalk. There is here not a syllable said about the American trias. I have always maintained the opinion that the fauna described by Gabb and Meek is upper triassic (Noric) (Ueber Daonella and Halobia. Abh. Geol. R.A., Bd. VII., Heft 2, p. 23.—Arktische Triasfaunen p. 149). To avoid the possibility of further erroneous interpretation I recall the fact that till the year 1892 when I rejected the "Juvavian Trias province," accepted up to that time, I designated as Juvavian types all those forms which are peculiar to the Hallstatt limestones, but are wanting in the rest of the Alpine triassic deposits, as for instance, the great number of upper triassic Tropitidæ and Haloritidæ.

[2] American Journal of Conchology, Vol. V.

[3] According to the suture-line given by Gabb this form cannot be an *Arcestes*. I consider the sutures to be much injured, either artificially or by weathering.

But it might also be supposed that *Acrochordiceras* ascends in the Pacific region into the lowest member of the Tyrolese series, for the vertical distribution of each genus in the different provinces is not necessarily the same in all cases. In illustration of this we refer to the genus *Trachyceras*, which in the Indian and the Pacific Provinces ascends to the Tuvalic fauna but is wanting in the Mediterranean Province.

Leaving this an open question we pass on to the discussion of the remaining fauna to which relationship the analogies with the lower Noric (Fassanic) Cephalopod fauna of North Japan point, as the following tabulation shows :—

NEVADA.	NORTH JAPAN.
Ceratites Blakei.	*Ceratites Japonicus.*
Ceratites Meeki.	*Ceratites Haradai.*
Ceratites nevadanus.	*Arpadites (Clionites)* sp.
Arpadites (Clionites) Whitneyi.	*Anolcites Gottschei.*
Anolcites americanus.	*Danubites Naumanni.*
Danubites Halli.	

The association of true *Ceratites* of normal dimensions with *Arpadites* and *Anolcites* as it is exhibited to us in the two small faunæ of Nevada and North Japan is characteristic of the Fassanic sub-stage of the Mediterranean Province, and to this I should like to assign that division of the Star-Peak Group which comprises the fauna tabulated above. If Meek's illustration be correct, *Anolcites Alphei* represents quite a peculiar type of which the symmetrical bundle-like arrangement of the ribs is characteristic. *Protrachyceras subasperum* is likewise a new type which is foreign to the Mediterranean Province.

The fossils collected in the triassic areas of British Columbia and described by Whiteaves in the "Contributions to Canadian Palæontology,"[1] and whose state of preservation often leaves much to be desired, evidently belong to different horizons. Having regard to the palæontological relationship of the forms represented it appears probable that the same stages exist in British Columbia as in Nevada and California; but judging from Whiteaves' illutrations one can conclude, with some probability, that the Carnic and the Juvavian stages are present. The existence of the Anisic stage here is also not yet proved with certainty, for the Ammonites described by Whiteaves as *Popanoceras Mc.Conelli* belong, as the drawing of the sutures shows, neither to the Anisic genus *Parapopanoceras*,[2] nor to the permian genus *Popanoceras*, but represent a new type of the Arcestidæ with prionidic sutures about whose stratigraphical position no certain conclusions can yet be drawn. *Trachyceras canadense* seems, according to Hyatt and Whiteaves, to be a true *Trachyceras* with divided external tubercles, and it would therefore point to the Carnic age, as *Trachyceras* is characteristic of the Carnic stage. The same conclusion is arrived at with respect to *Aulacoceras carlottense*, as the genus *Aulacoceras* has as yet been known only in the Carnic stage.

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[1] Vol. I., pp. 127-149., Pl. 17-19.

[2] Cf. p. 115 above.

The fragment of a volution figured as *Acrochordiceras* (?) *carlottense* might belong to a *Juvavites*.

The forms figured as *Arniotites*[1] and *Badiotites* cannot be employed for the determination of the horizon of the beds to which they belong, partly on account of their novelty and partly on account of their bad state of preservation. The presence, on the other hand, of *Pseudomonotis, subcircularis* shows that the Juvavian stage is here represented.

No newer data are available respecting the triassic deposits of South America (Columbia, Peru). They belong to the Juvavian stage and were remarked upon by me in the year 1886.[2]

The preceding observations only give a rough and incomplete sketch of the upper triassic deposits of the Arctic-Pacific Trias Province: the framework so to speak of their divisions and their chronological significance. Many local peculiarities may, nevertheless, be recognized which have already been pointed out in the course of this memoir. More precise conclusions would seem to me to be premature. They could only be arrived at after the palæontological working out of richer and fuller material.

If we glance at the whole vast region of the pelagic trias of the Thetys and the Arctic-Pacific Ocean, the restriction already emphasized in 1886 of the Tirolitidæ to the Mediterranean Province at the Scythian and the Dinaric periods, strikes us above all as one of the most important biological features. Only in the Noric period the Tirolitidæ, then endemic, spread from the Mediterranean Province over the great seas and penetrated as far as the eastern shores of the Pacific basin.

There can hardly be a doubt that the poor Cephalopod fauna of the Werfen beds extended from the eastern regions of the Thetys into the small

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[1] I distinguished at a time (1882) when one was much more sparing and cautious in the creation of new genera, three groups in the genus *Balatonites* established by myself (Ceph. der mediterranen Triasprovin, p. 77), *viz.*, the group of *B. gemmati*, the group of *B. arietiformes* and the group of *B. acuti*. Hyatt in 1889 (Contributions to Canadian Palæontology, Vol. I., by J. S. Whiteaves, p. 144) proposed to raise these three groups to the rank of genera, of which the group of *B. gemmati* should retain the name *Balatonites*, the group of *B. arietiformes*, however, should get the name of *Arniotites* and the group of *B. acuti* that of *Dorikranites*. But unfortunately Hyatt (l. c. p. 146) regarded as the type of the genus *Arniotites* a form from Vancouver Island which certainly cannot be assigned to my group of B. *arietiformes*. It is difficult to get a correct impression of the character and systematic position of this form from the very poor figure and insufficient description of *Arniotites Vancouverensis*. The figure as well as the description indicate that the inner whorls are completely smooth, and that the straight simple ribs, without tubercles, occur only in the anterior half of the penultimate whorl. The sutures and the length of the body-chamber are unknown. I am not able with the existing data to express any opinion upon the possible relationship of *Arniotites* to a European or Asiatic type. But for the group of *B. arietiformes*, as *Arniotites* has certainly nothing to do with it, a new generic name should be employed and I propose that of *Judicarites*. *Judicarites* has ceratitic sutures and whorls embracing to the extent of about one half. A median keel with faint tubercles is raised upon the truncated external part. The strong ribs, mostly undivided, occur on the outer whorls at wide intervals. They run straight across the sides and bend on the external part with knot-like swellings, knee-shaped towards the anterior.

[2] Arktische Triasfaunen, p. 151.

Mediterranean area. The migratory forms consisted, putting aside the isolated Meekocerata, only of Dinaritidæ from which then, perhaps under the influence of a temporary isolation, the Tirolitidæ branched off.

A later importation of foreign elements into the Mediterranean region occurred then in the Dinaric period. It extended also into the neighbouring Germanic basin, in which, however, probably likewise under the influence of a considerable isolation, a further special and independent development took place, while the Mediterranean gulf remained in open connection with the Thetys. The Indian regions of the Thetys[1] were in uninterrupted communication with the Arctic regions in the Scythian as well as in the Dinaric periods.

At the beginning of the Tyrolese epoch Tirolitidæ began their migration from the Mediterranean gulf through the Thetys into the great Pacific basin, which from this period, as it seems, increased in extent and pushed its shores farther and farther towards the south. The distribution of the Tirolitidæ over the vast areas of the Thetys and the Pacific region is a phenomenon of great biological importance and it seems therefore advisable to preserve the boundary between the Dinaric and Tyrolese series below the Fassanic fauna.

The Mediterranean gulf attained the greatest enrichment of its Cephalopod population at the time of the Julian fauna. Though the Indian fauna of this period is only imperfectly known, the most important of these genera, occurring independently, are likewise found in it. The knowledge of the fauna of this period is still more incomplete. But in the rich fauna of the Tuvalic period, immediately succeeding, we also meet with the same genera and types on the eastern coast of the Pacific basin as we do in India and in the Mediterranean Province. On a former occasion I have already referred to the apparently simultaneous occurrence of types in remote regions of the sea and I have dwelt upon the surprising fact that in the Mediterranean as well as in the Indian trias a concordant order of succession of each fauna can be proved.[2] It is now shown that this phenomenon also extends to the Pacific region and that it therefore comprises the whole vast region of the pelagic triassic deposits which are yet known to us. I confess that this result is rather unexpected. The farther we extend the borders of our knowledge the more difficult and enigmatical will the question become as to the habitat of the cryptogene types which play so important a part in the history of the pelagic animal world. It is true that vast regions of the surface of the earth are still closed to us, and at the time of the upper trias remarkable changes in the distribution of the continents and in the extent of the seas, especially in the region of the Pacific Ocean (cf. p. 143 above) must have taken place. We can therefore still hold to the opinion that the cryptogene types originated from marine areas which are yet unknown to us. And in a similar way it must, in judging of this class of phenomena, be borne in mind that changes in the physical character of the surface of the earth must have most materially influenced the distribution of the organic beings thereon.

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[1] The probable objection, that Noric faunæ are yet unknown in the Indian Province, can be met by pointing out the small circumference of the more closely examined area. The want of sediments in the sections so far studied seems to be the cause of the absence of Noric stage. In any case the connection between the Mediterranean Province and the Pacific Ocean is only conceivable by means of the Thetys.

[2] Cephalopoden der Hallstätter Kalke, II. Bd., p. 827.

Series.	Stages.	Sub-stages.	Zones of the Mediterranean Province.	Germanic Basin.	Asia Minor.
BAJUVARIAN.	Rhætic	Rhætic	22. Zone of *Avicula contorta*	Bone-bed.	
	Juvavian.	Sevatic	21. Zone of *Sirenites Argonautæ*		Fauna of Balia Maaden.
			20. Zone of *Pinacoceras Metternichi*		
		Alaunic	19. Zone of *Cyrtopleurites bicrenatus.*		
		Lacic	18. Zone of *Cladiscites ruber*		
			17. Zone of *Sagenites Giebeli*		
TYROLESE.	Carnic.	Tuvalic	16. Zone of *Tropites subbullatus*		
		Julian.	15. Zone of *Trachyceras Aonoides*		
		Cordevolic	14. Zone of *Trachyceras Aon*		
	Noric.	Longobardic.	13. Zone of *Protrachyceras Archelaus.*		
		Fassanic.	12. Zone of *Dinarites avisianus*	*Ceratites Schmidi*?	
			11. Zone of *Protrachyceras Curionii.*	Zone of *Ceratites nodosus.*	
DINARIC.	Anisic	Bosnian	10. Zone of *Ceratites trinodosus*	Trochites Limestone	Fauna of the Gulf of Ismid?
		Balatonic	9. Zone of *Ceratites binodosus*	Zone of *Ceratites antecedens.*	
	Hydaspic	Hydaspic		*Hungarites Strombecki.*	
SCYTHIAN.	Jakutic.	•	Zone of *Tirolites cassianus*	*Beneckeia tenuis.*	
		Jakutic.		Buntsandstein.	
	Brahmanic	Gandaric			
		Gangetic			

of the Thetys.

Armenia.	Baluchistán.	Pamir.	INDIAN PROVINCE.		East Indian Archipelago.
			Himálaya.	Salt Range.	
			Hochgebirgskalk ?	Variegated Series.	
		Rocks with *Monotis salinaria* and *Halorella.*	"Sagenites beds" ?		*Monotis salinaria* of Rotti.
	Didymites.		Beds with *Spiriferina Griesbachi*		
			Zone of *Steinmannites undulato-striatus.*		
			Zone of *Clydonautilus Griesbachi*		
			Tropites Limestone of Kalapani		
			a. Daonella beds b. Beds of *Trach. tibeticum.*	*Pseudharpoceras spiniger* ?	*Halobia* and *Daonella* of Rotti.
			Zone of *Ptychites rugifer.*		
			Zone of *Sibirites Prahlada.*		
				8. Zone of *Stephanites superbus.*	
Clarai beds of the Araxes Pass.			Beds with *Ceratites subrobustus.*	7. Zone of *Flemingites Flemingianus.* 6. Zone of *Flemingites radiatus.* 5. Zone of *Ceratites normalis.* 4. Zone of *Proptychites trilobatus.* 3. Zone of *Proptychites Lawrencianus*	
				2. Zone of *Gyronites frequens.*	
			1. Zone of *Otoceras Woodwardi.*		

Series.	Stages.	Sub-stages.	Australia and New Zealand.	New Caledonia.	Japan.	Ussuri Region.	Werchojansk and the Gulf of Okhotsk.
BAJUVARIAN.	Rhætic	Rhætic					
	Juvavian.	Sevatic	Beds with *Pseudomonotis ochotica.*	Beds with *Pseudomonotis ochotica and Stenarcestes.*	Beds with *Pseudomonotis ochotica.*		Beds with *Pseudomonotis ochotica.*
		Alaunic.					
		Lacic.					
TYROLESE.	Carnic.	Tuvalic.					
		Julian.					
		Cordevolic.					
	Noric.	Longobardic.					
		Fassanic			Beds with *Ceratites japonicus.*		
DINARIC.	Anisic.	Bosnian				Beds with *Monophyllites sichoticus.*	
		Balatonic.					
	Hydaspic.	Hydaspic.					
SCYTHIAN.	Jakutic.	Jakutic.					
	Brahmanic.	Gandaric				Beds with *Proptychites hiemalis.*	
		Gangetic.					

the Arctic-Pacific Ocean.

New Siberian Islands, mouth of the Olenek.	Spitsbergen.	Idaho.	Alaska and British Columbia.	Nevada and California.	Columbia, Peru.
			Beds with *Pseudomonotis subcircularis.*	Swearing slates with *Rhabdoceras Russelli* and *Pseudomonotis subcircularis.*	Beds with *Pseudomonotis ochotica.*
			Probably agreeing with Nevada and California.		
				Hosselkus limestone with *Tropites.*	
				Homfrayi beds.	
				Star-Peak Group.	
				Beds with *Anolcites americanus.*	
Beds with *Hungarites triformis*	*Daonella* limestone.				
	Posidonomya limestone.				
Olenek beds with *Ceratites subrobustus.*		*Meekoceras* beds.			

PLATE I.

HALORITES.

HALORITES PROCYON, E. v. Mojs., p. 9. (Cf. Pl. II., Pl. III., Figs. 1, 2.)

Fig. 1. VAR. OBLIQUA. Nearly complete specimen with the body-chamber, most of it a cast. From the Halorites Limestone of the Bambanag Section.

„ 2. VAR. OBLIQUA. Incomplete specimen, for the most part without the test, with half a whorl of the body-chamber. From the same locality.

„ 3. VAR. OBLIQUA. Chambered cast with only a little of the test remaining. From the same locality.

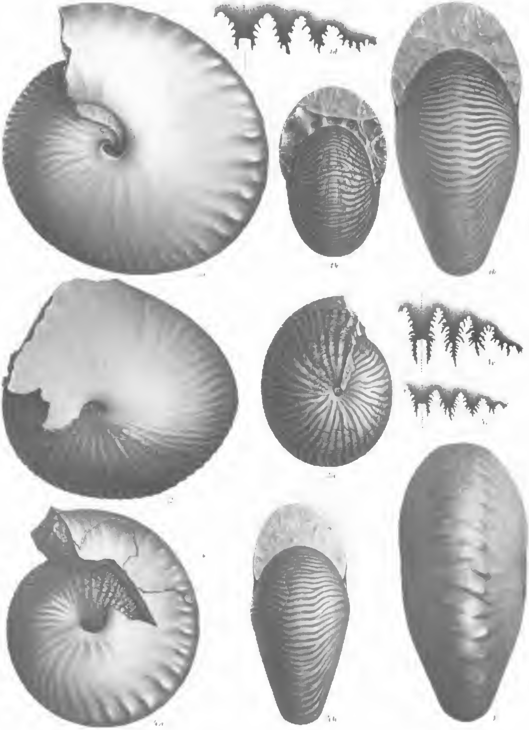
„ 4. VAR. RECTA. Specimen with the body-chamber and the apertural margin, most of it a cast. From the same locality.

All the figures are of the natural size, and were drawn on the stone without the use of a reflector.

UPPER TRIAS. HIMÁLAYA. VOL:III.

Geological Survey of India.

Pl. I.



R. Mayer del.et.lith.

Th. Bannwarth print.

PLATE II

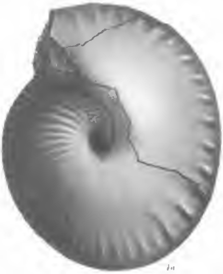
HALORITES.

HALORITES PROCYON, E. v. Mojs., p. 9. (Cf. Pl. I and Pl. III, Figs. 1, 2.)

Fig. 1. VAR. OBLIQUA. Nearly complete specimen with the body-chamber; most of it a cast. From the Halorites Limestone of the Bambanag Section.

„ 2. VAR. RECTA. Cast of a nearly complete specimen with the body-chamber. From the same locality.

The figures are of the natural size, and were drawn directly on the stone without the use of a reflector.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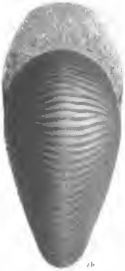
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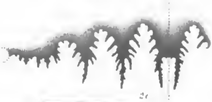
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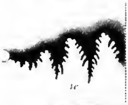
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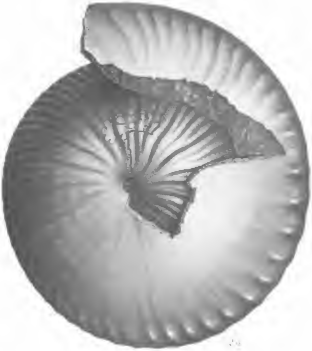
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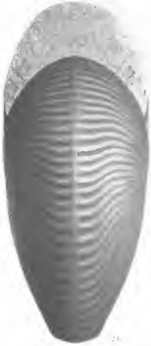
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R. Mayer del. et lith.

Th. Bannwarth print.

PLATE III.

Halorites.

Halorites procyon, E. v. Mojs., p. 9. (Cf. Pl. I, Pl. II.)

Fig. 1. Var. recta. Internal cast with the test, with fragment ot cast of the last whorl of the body-chamber. From the Halorites Limestone of the Bambanag Section.

„ 2. Var. recta. Cast of a fragment with the body-chamber. From the same locality.

„ 3. Halorites alcaci, E. v. Mojs., p. 17. Specimen with the body-chamber and part of the test; provided with the aperture. From the same locality. In the figures 3c and 3d part of the last whorl was removed in order to represent the external part of the penultimate whorl.

„ 4. Halorites Charaxi, E. v. Mojs., p. 15. Nearly complete specimen with the body-chamber, most of it without any test. From the same locality.

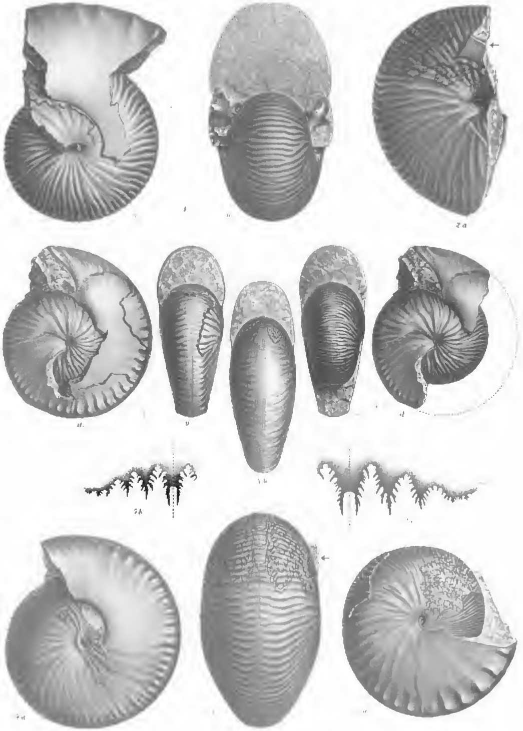
„ 5 Halorites phaonis, E. v. Mojs., p. 16. (Cf. Pl. V, Fig. 1.) Varietas. Incomplete specimen, most of it without the test, with part of the body-chamber whorl. From the same locality.

All the figures are of the natural size, and were drawn directly on the stone without the use of a reflector.

Geological Survey of India.

UPPER TRIAS, HIMÁLAYA. VOL: III.

Pl. III.



R. Mayer del. et lith.

Th. Bannwarth print.

PLATE IV.

HALORITES.

HALORITES SAPPHONIS, E. v. Mojs., p. 13.

Fig. 1. Specimen with the body-chamber and part of the test. From the Halorites Limestone of the Bambanag Section.

" 2. Chambered cast with the beginning of the modified body-chamber whorl. From the same locality.

" 3. Specimen with part of the test and provided with half of the body-chamber whorl, placed in the position of a complete example of the body-chamber, of which the last half whorl has been removed. From the same locality.

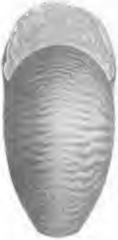
" 4. Cast of a nearly complete specimen with the body-chamber. From the same locality.

All the figures are of the natural size, and were drawn directly on the stone without the use of a reflector.

Geological Survey of India.

UPPER TRIAS, HIMÁLAYA. VOL: III.

Pl. IV.



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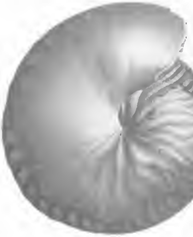
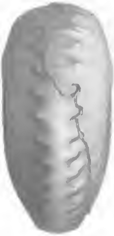


1 a.



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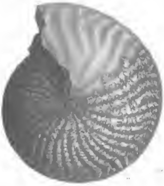

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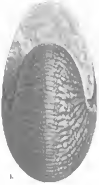

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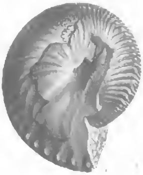

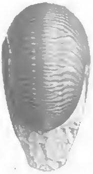

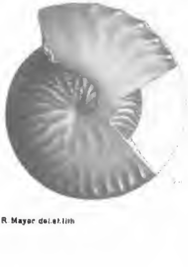

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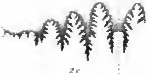

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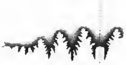

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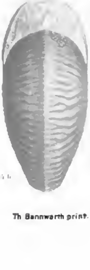


3 b

R. Mayer del. et lith.

Th. Bannwarth print.

PLATE V.

HALORITES.

Fig. 1. HALORITES PHAONIS, E. v. Mojs., p. 16. (Cf. Pl. III, Fig. 5.)
TYPE. Full-grown specimen provided with the apertural margin. Cast, from the Halorites Limestone of the Bambanag Section.

PARAJUVAVITES.

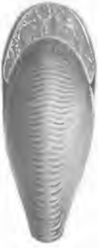
„ 2. PARAJUVAVITES BLANFORDI, E. v. Mojs., p. 20. (Cf. Pl. VIII, Figs. 6 and 7.)
VARIETAS OBLIQUA. Cast with an incomplete body-chamber, from the Halorites Limestone of the Bambanag Section.

„ 3. PARAJUVAVITES LAUKANUS, E. v. Mojs., p. 22. Calcified full-grown specimen with the test, and nearly completely preserved apertural margin, from Lauka E. G., probably from the Halorites Limestone.

„ 4. PARAJUVAVITES STERNBERGI, E. v. Mojs., p. 22. Full-grown specimen with the nearly complete body-chamber. Cast, from the Halorites Limestone of the Bambanag Section.

All the figures are of the natural size and were drawn directly on the stone without the use of a reflector.

Pl. V.



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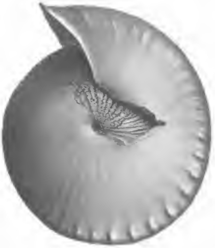

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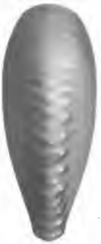

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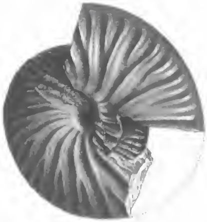

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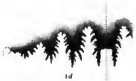

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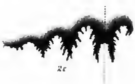

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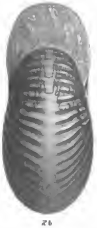

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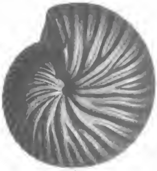

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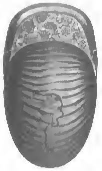

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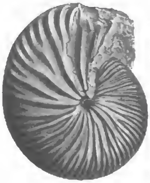

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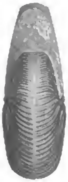


4b

R. Mayer del. et lith.

Th. Bannwarth print.

PLATE VI.

Parajuvavites.

Parajuvavites Feistmanteli, Griesbach, p. 24.

Fig. 1. Full-grown specimen, nearly complete. Cast, with some remnants of the test. From the Halorites Limestone of the Bambanag Section.

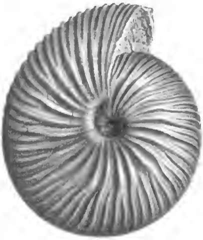
" 2. Chambered internal cast. From the same locality.

" 3. Plan of the sutures after Griesbach's original specimen from Kimkin Paiar.

Parajuvavites jacquini, E. v. Mojs., p. 25. (Cf. Pl. VII, Figs. 1, 2.)

Figs. 4, 5, 6, 7. Full-grown specimens with the body-chambers preserved; casts with slight portions of test. From the Halorites Limestone of the Bambanag Section.

All the figures are of the natural size, and were drawn directly on the stone without the use of a reflector.



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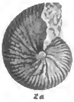

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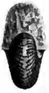

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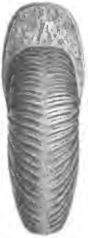

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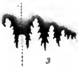

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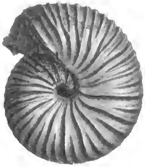

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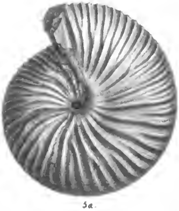

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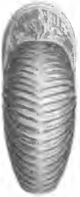

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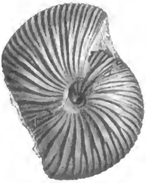

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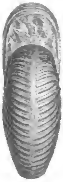

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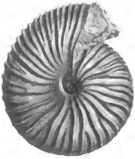

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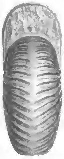


7b

R. Mayer del. et lith.

Th. Bannwarth print.

PLATE VII.

PARAJUVAVITES.

PARAJUVAVITES JACQUINI, E. v. Mojs., p. 25. (Cf. Pl. VI, Figs. 4—7.)

Fig. 1. Body-chamber of a full-grown specimen; a cast. From the Halorites Limestone of the Bambanag Section.

" 2. Full-grown form with the penultimate whorl; a cast. From the same locality.

PARAJUVAVITES TYNDALLI, E. v. Mojs., p. 27.

" 3. Full-grown specimen with the body-chamber; a cast. From the Halorites Limestone of the Bambanag Section.

" 4. Penultimate suture-line of a full-grown specimen from the same locality.

PARAJUVAVITES RENARDI, E. v. Mojs., p. 28.

" 5. Cast of a full-grown complete specimen. From the same locality.

" 6. PARAJUVAVITES MINOR, E. v. Mojs., p. 30. Full-grown nearly complete specimen, a cast with portions of the test.

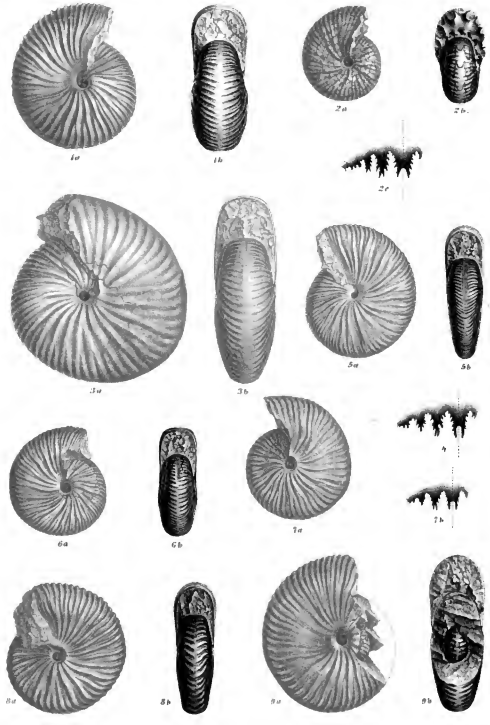
Figs. 7, 8 and 9. PARAJUVAVITES LUDOLFI, E. v. Mojs., p. 29. Full-grown specimens (Fig. 8 with the aperture preserved); casts, from the Halorites Limestone of the Bambanag Section.

All the figures are of the natural size, and were drawn on the stone without the use of a reflector.

Geological Survey of India.

UPPER TRIAS, HIMÁLAYA. VOL:III.

Pl.VII.



R. Mayer del.et.lith.

Th. Bannwarth print.

PLATE VIII.

PARAJUVAVITES.

PARAJUVAVITES BUDDHAICUS, E. v. Mojs., p. 31.

Fig. 1. TYPE. Nearly complete, full-grown specimen with the body-chamber; a cast from the Halorites Limestone of the Bambanag Section.

" 2. VARIETAS. Full-grown specimen with the body-chamber, not quite complete. A cast from the same locality.

" 3. Full grown specimen with the anterior part of the body-chamber broken off. A cast with some remnants of the test. From the same locality.

" 4. Full-grown specimen with the penultimate whorl, of which the last whorl, comprising the body-chamber, has been removed. A cast with portions of the test. From the same locality.

" 5. Internal cast without the test. From the same locality.

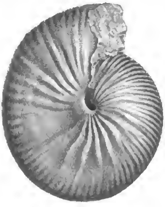
PARAJUVAVITES BLANFORDI, E. v. Mojs., p. 20. (Cf. Pl. V, Fig. 2.)

" 6. VARIETAS RECTA. Cast of a nearly complete, full-grown specimen, from the Halorites Limestone of Bambanag.

" 7. A young specimen with the body-chamber; a cast with some portions of the test. From the same locality.

All the figures are of the natural size, and were drawn on the stone without the use of a reflector.

Geological Survey of India. UPPER TRIAS, HIMÁLAYA. VOL:III. Pl. VIII.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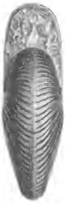
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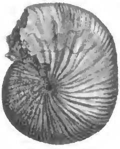
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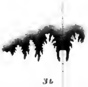
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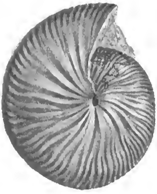
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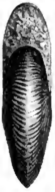
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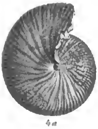
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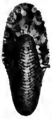
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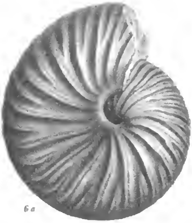
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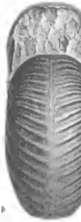
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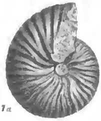
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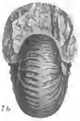
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R. Mayer del.et.lith.

Th. Bannwarth print.

PLATE IX.

PARAJUVAVITES.

Fig. 1. PARAJUVAVITES, nov. f. ind., p. 34. Specimen with an incomplete body-chamber; a cast from the Halorites Limestone of the Bambanag Section.

PARAJUVAVITES STOLICZKAI, E. v. Mojs., p. 33.

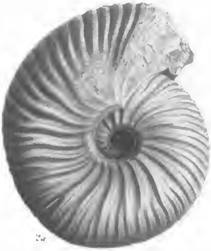
„ 2. More finely ribbed variety. Full grown specimen with the body-chamber; a cast from the Halorites Limestone of the Bambanag Section.

„ 3. More coarsely ribbed variety. Cast of a full-grown specimen with the body-chamber. From the same locality.

JOVITES.

Figs. 4, 5. JOVITES, nov. f. ind., ex aff. J. BOSNENSIS, p. 18. Fragments with part of the test and with the anterior part of the body-chamber. From the red limestone of the Kiogarh Range, south of Sangcha Talla.

All the figures are of the natural size, and were drawn on the stone without the use of a reflector.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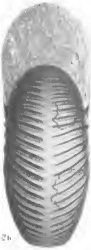
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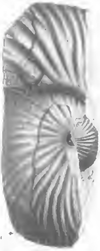
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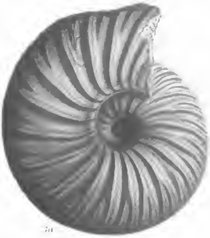
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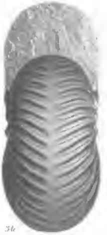
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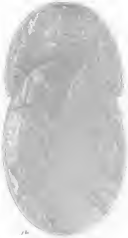
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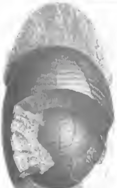
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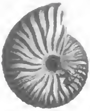
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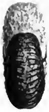
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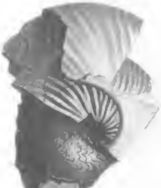
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R. Mayer del. et lith.

Th. Bannwarth print.

PLATE X.

HERACLITES (GUEMBELITES).

Fig. 1. HERACLITES (GUEMBELITES) JANDIANUS, E. v. Mojs. p. 74. Specimen with the body-chamber; a cast with some portions of the test, from the débris on the eastern slopes of the Iandi Pass. Probably from the Halorites Limestone.

JUVAVITES (GRIESBACHITES).

" 2. JUVAVITES (GRIESBACHITES) MEDLEYANUS, Stoliczka, p. 38. Chambered cast, from the black limestone, probably belonging to the Daonella beds.

" 3. JUVAVITES (GRIESBACHITES) HANNI, E. v. Mojs., p. 39. Thicker variety. Calcified fragment; from the Daonella beds of Lauka.

" 4. J. (G.) HANNI, TYPE. Chambered calcified cast, somewhat distorted. From the same locality.

" 5. Calcified fragment, from the Daonella beds of the Bambanag Section (bed No. 4).

SAGENITES.

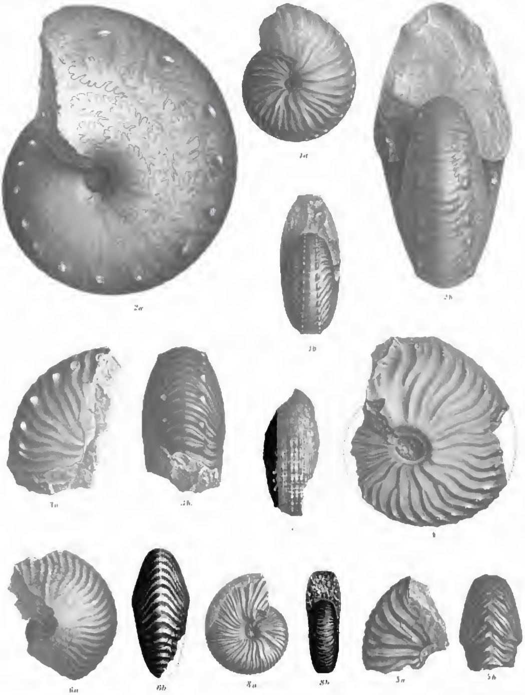
" 6. SAGENITES, nov. f. ind., p. 42. Chambered fragment, most of it with the test, from the limestone with PINACOCERAS cf. IMPERATOR (No. 6) of the Bambanag Section.

" 7. SAGENITES, nov. f. ind., p. 43. Chambered fragment, from the bivalve-beds (No. 9) Hochgebirgskalk at the base of the limestone of the high mountains of the Bambanag Section.

PARAJUVAVITES.

" 8. PARAJUVAVITES BRINTONI, E. v. Mojs., p. 30. Cast of a full-grown specimen with the body-chamber, from the Halorites Limestone of the Bambanag Section.

All the figures are of the natural size and were drawn directly on the stone without the use of a reflector.



R Mayer del. et lith.

Th. Bannwarth print.

PLATE XI.

Anatomites (Juvavites).

Fig. 1. **Anatomites bambanagensis**, E. v. Mojs., p. 35. Cast with the anterior half of the last whorl, consisting of the body-chamber; from the Daonella beds of the Bambanag Section.

„ 2. **Anatomites Caroli**, E. v. Mojs., p. 37. Pyritised cast; from the Daonella beds of Rimkin Paiar.

„ 3. **Anatomites Eugenii**, E. v. Mojs., p. 36. Pyritised cast; from the Daonella beds of Rimkin Paiar.

Tropites.

„ 4. **Tropites**, nov. f. ind. cf. Trop. acutangulus, p. 46. Chambered cast, from the Tropites Limestone of Kalapani.

„ 5. **Tropites**, ind. cf. Trop. fusobullatus, p. 47. Chambered cast, from the Tropites Limestone of Kslapani.

„ 6. **Tropites**, nov. f. ind., p. 47. Fragment of a chambered cast, from the Tropites Limestone of Kalapani.

„ 7. **Tropites**, ind. cf. Tropites discobullatus, p. 48. Chambered cast, from the Tropites Limestone of Kalapani.

„ 8. **Tropites kalapanicus**, E. v. Mojs., p. 45. Cast with a great part of the body-chamber, from the Tropites Limestone of Kalapani.

Trachyceras.

„ 9. **Trachyceras**, nov. f. ind., p. 90. Cast, from the Tropites Limestone of Kslapani.

Sagenites.

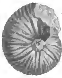
„ 10. **Sagenites**, nov. f. ind., p. 41. Chambered specimen with badly preserved test, from the Daonella beds of the Bambanag Section.

Thetidites.

„ 11. **Thetidites Guidonis**, E. v. Mojs., p. 54. Incomplete specimen with the body-chamber and part of the test, from the Halorites Limestone of the Bambanag Section.

„ 12. **Thetidites Huxleyi**, E. v. Mojs., p. 52. (Cf. Pl. XII., Figs. 1—4.) Sutures of a specimen, from the Halorites Limestone of the Bambanag Section.

All the figures are of the natural size, and were drawn directly on the stone without the use of a reflector.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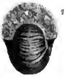
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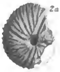
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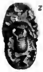
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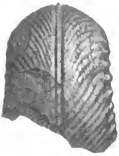
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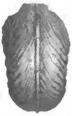
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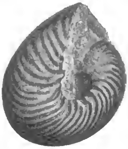
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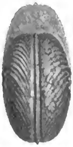
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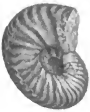
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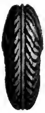
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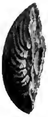
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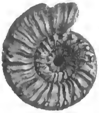
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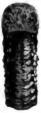
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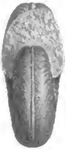
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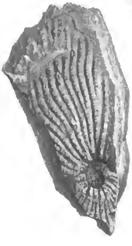
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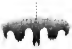
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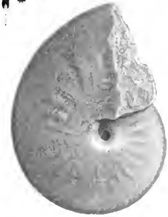
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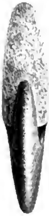
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R. Mayer del.et lith.

Th. Bannwarth print.

PLATE XII.

THETIDITES.

THETIDITES HUXLEYI, E. v. Mojs., p. 52. (Cf. Pl. XI., Fig. 12.)

Fig. 1. Specimen with nearly complete body-chamber. From the Halorites Limestone of the Bambanag Section.

„ 2. Specimen with the body-chamber and part of the test. From the same locality.

„ 3. Incomplete specimen with the body-chamber and part of the test. From the same locality.

„ 4. Full-grown individual with part of the test and a portion of the body-chamber. From the same locality.

HELICTITES.

„ 5. HELICTITES ATALANTA, E. v. Mojs., p. 55. Specimen with the body-chamber and portions of the test. From the Halorites Limestone of the Bambanag Section.

STEINMANNITES.

„ 6. STEINMANNITES CLIONITOIDES, E. v. Mojs., p. 68 Chambered fragment with remnants of the test on the inner whorls. From the Halorites Limestone of the Bambanag Section.

„ 7. STEINMANNITES DESIDERII, E. v. Mojs., p. 69. Chambered fragment with portions of the test on the inner whorls. From the Halorites Limestone of the Bambanag Section.

STEINMANNITES NOETLINGI, E. v. Mojs., p. 70.

„ 8. Specimen with the body-chamber and parts of the test. From the Halorites Limestone of the Bambanag Section.

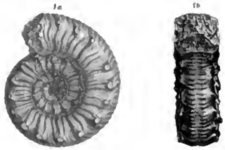
„ 9. VARIETAS. Specimen with the body-chamber, and part of the test. From the same locality.

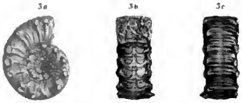
All the figures are of the natural size, and were drawn directly on the stone without the use of a reflector.

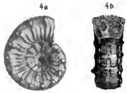
UPPER TRIAS, HIMÁLAYA. VOL:III.

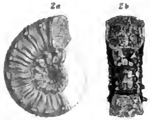
Geological Survey of India.

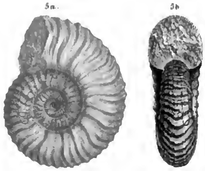
Pl.XII.

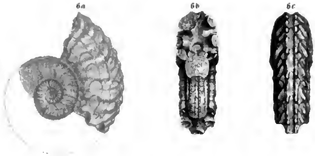


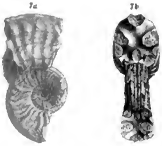


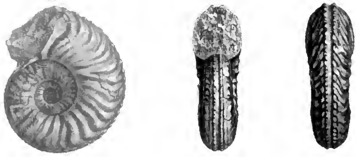


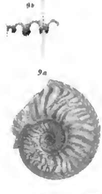












R. Mayer del.et.lith.

Th. Bannwarth print.

PLATE XIII.

Steinmannites.

Fig. 1. Steinmannites undulatostriatus, E. v. Mojs., p. 66. Specimen with the beginning of the body-chamber and the test only on the inner whorls. From the Halorites Limestone of the Bambanag Section.

„ 2. Steinmannites Lubbocki, E. v. Mojs., p. 71. Chambered specimen with part of the test. From the Halorites Limestone of the Bambanag Section.

„ 3. Specimen of the body-chamber; a cast, from the same locality.

Clionites.

Clionites Woodwardi, E. v. Mojs., p. 61.

„ 4. Type. Specimen, with part of the test and with the beginning of the body-chamber. From the Halorites Limestone of the Bambanag Section.

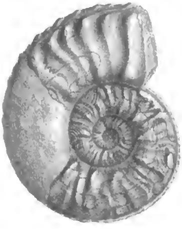
„ 5. Varietas crassa. Chambered fragment, most of it a cast. From the same locality.

„ 6. Type } Clionites Salteri, E. v. Mojs., p. 62.
„ 7. Varietas } Chambered casts. From the Halorites Limestone of the Bambanag Section.

„ 8. Clionites aberrans, E. v. Mojs., p. 63. Fragment with the test and with part of the body-chamber. From the Halorites Limestone of the Bambanag Section.

All the figures are of the natural size, and were drawn directly on the stone without the use of a reflector.

Geological Survey of India. UPPER TRIAS, HIMÁLAYA. VOL:III. Pl. XIII.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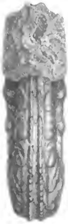
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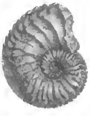
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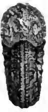
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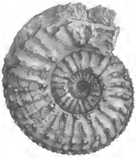
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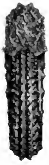
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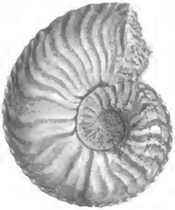
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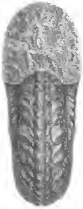
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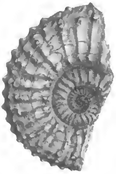
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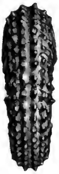
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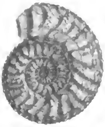
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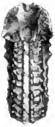
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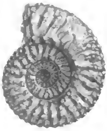
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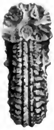
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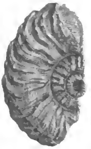
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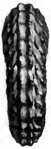
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R. Mayer del. et lith. Th. Bannwarth print.

PLATE XIV.

Clionites.

Fig. 1. Clionites Hughesi, E. v. Mojs., p. 64. Type. Specimen with the body-chamber, most of it a cast. From the Halorites Limestone of the Bambanag Section.

Figs. 2, 3. Cl. Hughesi, Varietates. Specimens with the body-chamber and slight remnants of the test. From the same locality.

Fig. 4. Clionites, nov. f. ind., p. 65. Specimen with the beginning of the body-chamber, most of it a cast. From the Halorites Limestone of the Bambanag Section.

„ 5. Clionites spinosus, E. v. Mojs., p. 66. Specimen with the body-chamber and part of the test. From the Halorites Limestone of the Bambanag Section.

Arpadites.

„ 6. Arpadites rimkinensis, E. v. Mojs., p. 59. Specimen, with the test. From the Crinoidal Limestone, with Trachyceras tibeticum from Rimkin Paiar.

„ 7. Arpadites lissarensis, E. v. Mojs., p. 60. Fragment, with the test and with a part of the body-chamber. From grey limestone (with Joannites cf. cymbiformis) of the Lissar Valley.

Dittmarites.

„ 8. Dittmarites Hindei, E. v. Mojs., p. 60. Chambered specimen, with part of the test. From the Halorites Limestone of the Bambanag Section.

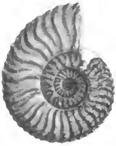
Anatibetites.

„ 9. Anatibetites Kelvini, E. v. Mojs., p. 80. Specimen with the body-chamber; a cast from the Halorites Limestone of the Bambanag Section.

Thisbites.

„ 10. Thisbites (?) meleagri, E. v. Mojs., p. 56. Specimen with the test. From the black limestone of Tera Gadb, N. of Kalapani.

All the figures are of the natural size, and were drawn directly on the stone without the use of a reflector.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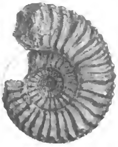
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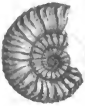
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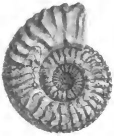
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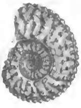
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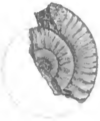
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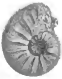
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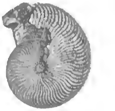
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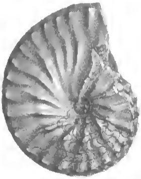
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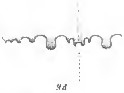
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R. Mayer del. et lith.

Th. Bannwarth print

PLATE XV.

Paratibetites.

Fig. 1. Paratibetites Bertrandi, E. v. Mojs., p. 82. Chambered cast. From the Halorites Limestone of the Bambanag Section.

„ 2. Paratibetites Geikiei, E. v. Mojs., p. 83. Chambered specimen, with some portions of the test. From the Halorites Limestone of the Bambanag Section.

Paratibetites Adolphi, E v. Mojs., p. 84.

„ 7. Specimen, with the body-chamber and some remnants of the test. From the Halorites Limestone of the Bambanag Section.

„ 8. Chambered specimen, with part of the test. From the same locality.

„ 9. Varietas. Chambered specimen, with part of the test. From the same locality.

„ 10. Varietas. Specimen, with the body-chamber and part of the test. From the same locality.

Tibetites.

Tibetites Ryalli, E. v. Mojs., p. 77.

„ 3. Specimen, with the beginning of the body-chamber and part of the test. From the Halorites Limestone of the Bambanag Section.

„ 4. Fragment of the body-chamber, with part of the test. From the same locality.

„ 5. Tibetites Murchisoni, E. v. Mojs., p. 78. Specimen, with the body-chamber and part of the test. From the Halorites Limestone of the Bambanag Section.

„ 6. Tibetites Perrin Smithi, E. v. Mojs., p. 79. Specimen with the body-chamber and portions of the test. From the Halorites Limestone of the Bambanag Section.

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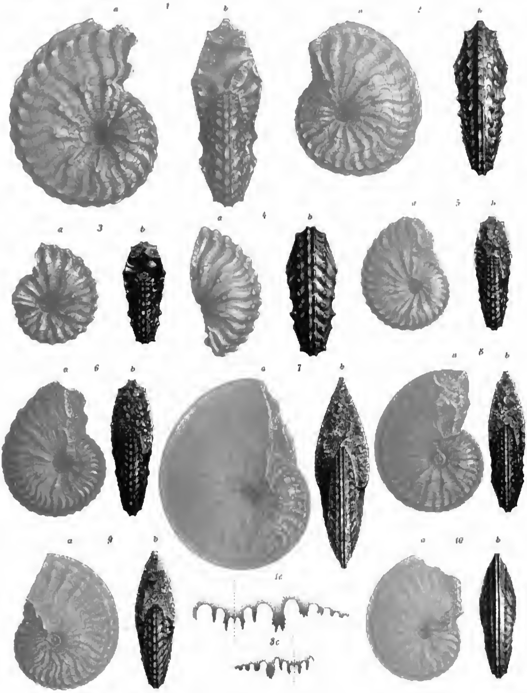

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PLATE XVI.

PARATIBETITES.

PARATIBETITES ANGUSTOSELLATUS, E. v. Mojs., p. 86.

Fig. 1. Chambered cast. From the Halorites Limestone of the Bambanag Section.
„ 2. Chambered specimen with part of the test. From the same locality.
„ 3. VARIETAS. Chambered specimen, with part of the test. From the same locality.
„ 4. Plan of the sutures from a type specimen. From the same locality.

PARATIBETITES TORNQUISTI, E. v. Mojs., p. 87.

„ 5. Chambered cast from the Halorites Limestone of the Bambanag Section.

HAUERITES.

HAUERITES (?), nov. f. ind., p. 88.

„ 6. Plan of the sutures of a fragment. From the black arenaceous limestone of the bed No. 6 of the Bambanag Section.

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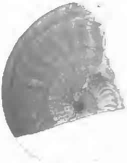

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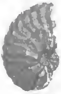

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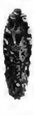

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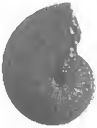

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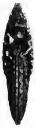

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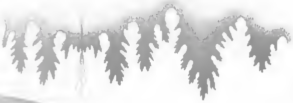

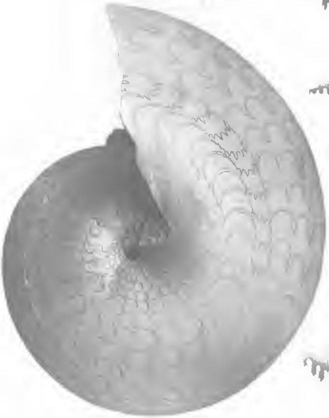

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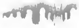

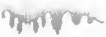

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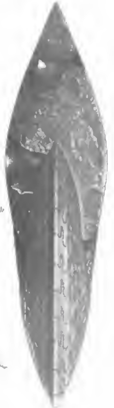

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PLATE XVII.

Sandlingites.

Sandlingites Nicolai, E. v. Mojs., p. 91.

Fig. 1. Chambered cast. From the Halorites Limestone of the Bambanag Section.

„ 2. External view of the cast with the body-chamber. From the same locality.

Sandlingites Archibaldi, E. v. Mojs., p 92.

„ 3. Specimen with the body-chamber, without the test on the outer whorl. From the Halorites Limestone of the Bambanag Section.

„ 4. Varietas. Specimen with the body-chamber, without the test on the outer whorl. From the same locality.

„ 5. Chambered cast. From the same locality.

Group of Protrachycerata valida.

„ 6. Protrachyceras ralphuanum, E. v. Mojs., p. 89. Chambered specimen with the test, from the black limestone, facing the Ralphu Glacier.

Group of Trachycerata duplica.

„ 7. Trachyceras tibeticum, E. v. Mojs., p. 90. Cast with the beginning of the body-chamber, from the crinoidal limestone of Rimkin Paiar.

Group of Sirenites argonautæ.

Sirenites elegans, E. v. Mojs., p. 93.

„ 8. Chambered cast, from the Halorites Limestone of the Bambanag Section.

„ 9. Chambered fragment with the test. From the same locality.

„ 10. Sirenites Richteri, E. v. Mojs., p. 94. Chambered fragment with the test, from the Halorites Limestone of the Bambanag Section.

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PL.XVII.

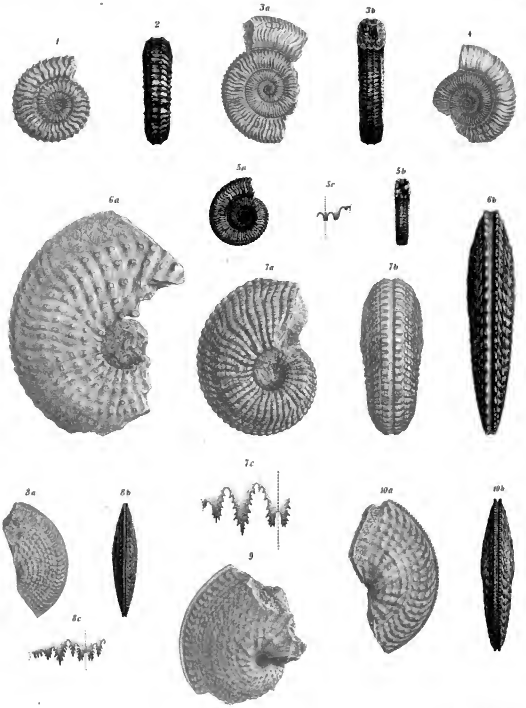

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PLATE XVIII.

BAMBANAGITES.

BAMBANAGITES SCHLAGINTWEITI, E. v. Mojs., p. 107.

Fig. 1. Specimen with nearly complete body-chamber and part of the test. From the Halorites Limestone of the Bambanag Section.

„ 2. Chambered specimen with part of the test. From the same locality.

Figs. 3, 4, 5 and 6. BAMBANAGITES DIENERI, E. v. Mojs., p. 108. Specimens with body-chamber and with portions of the test. From the Halorites Limestone of the Bambanag Section.

PINACOCERAS.

PINACOCERAS PARMA, E. v. Mojs., p. 105.

Fig. 7. Chambered specimen with sutures indicated on the figure and remnants of the test. From the Halorites Limestone of the Bambanag Section.

„ 8. Plan of the suture-line of a specimen from the same locality.

PLACITES.

„ 9. PLACITES, ind. ex. aff. Pl. peraucti, p. 111. Fragment of a chambered specimen. From the upper Daonella beds of the Bambanag Section.

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Pl.XVIII.

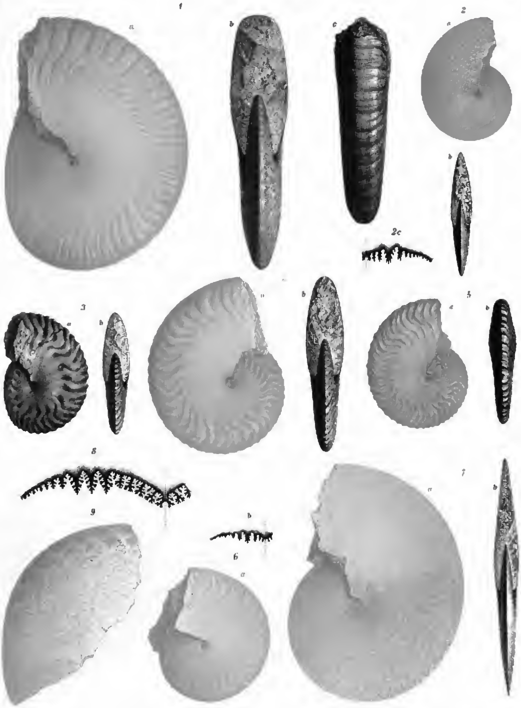

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PLATE XIX.

PINACOCERAS.

Fig. 1. PINACOCERAS, sp. ind., ex aff. P. Imperatoris, p. 106. Fragment of a chambered cast from the Limestone complex No. 6 of the Bambanag Section. The umbilical margin is visible on the lower part of the figure by a slight displacement.

PLACITES.

" 2. PLACITES OLDHAMI, E. v. Mojs., p. 111. Chambered specimen, with remnants of the test. From the Daonella beds of Lauka.

Figs. 3, 4, 5. PLACITES SAKUNTALA, E. v. Mojs., p. 112. Chambered forms with part of the test. From the Halorites Limestone of the Bambanag Section (3 d, sutures at the beginning, 3 c, at the end of the last whorl).

PHYLLOCERAS.

Fig. 6. PHYLLOCERAS (MOJSVÁRITES) EBNERI, E. v. Mojs., p. 116. Chambered specimen, with part of the test. From the Daonella beds of Lauka.

MOJSVÁRITES.

" 7. MOJSVÁRITES EUGYRUS, E. v. Mojs., p. 114. Chambered specimen, with the test. From the Daonella beds of the Bambanag Section.

PTYCHITES.

PTYCHITES POSTHUMUS, E. v. Mojs., p. 117.

" 8. Chambered internal cast without the test. From the black limestone facing the Ralphu Glacier.

" 9. Specimen with the body-chamber, most of it without the test. From the same locality.

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Pl. XIX

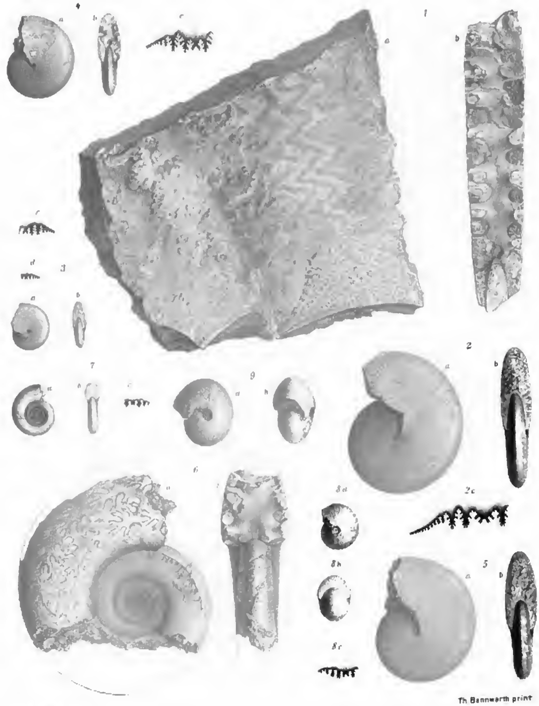

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PLATE XX.

PARACLADISCITES.

Fig. 1. PARACLADISCITES INDICUS, E. v. Mojs., p. 103. Chambered cast, with some remnants of the test. From the black limestone of Kuling (Spiti).

CLADISCITES.

" 2. CLADISCITES SUBARATUS, E. v. Mojs., p. 102. Chambered fragment, with the test. From the black limestone of the Daonella beds of Lauka.

JOANNITES.

" 3. JOANNITES cf. cymbiformis (Wulfen), p. 101. Chambered cast. From the grey Traumatocrinus limestone of Rimkin Paiar.

" 4. Plan of the sutures of a specimen from the same locality.

ARCESTES.

ARCESTES LEONARDI, E. v. Mojs., p. 98.

" 5. Specimen, with the body-chamber and the test. From the Halorites Limestone of the Bambanag Section.

" 6. Specimen, with the body-chamber broken at the aperture, in order to show the last lip. From the same locality.

" 7. Chambered form, with the test. From the same locality.

" 8. Plan of the sutures of a specimen. From the same locality.

" 10. ARCESTES SUBBICORNIS, E. v. Mojs., p. 99. Specimen with the body-chamber and the test. From the black limestone of Tera Gadh.

DIDYMITES.

" 9. DIDYMITES AFGHANICUS, E. v. Mojs., p. 44. Chambered form. From the black limestone of the Zhob Valley.

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Pl. XX.

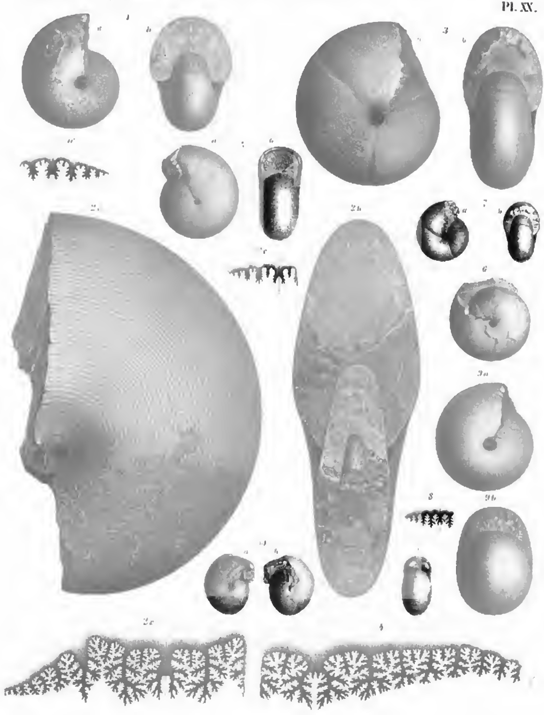

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PLATE XXI.

NAUTILUS.

Fig. 1. NAUTILUS BAMBANAGENSIS, E. v. Mojs., p. 122. From a cast, with the body-chamber. From the Halorites Limestone of the Bambanag Section.

„ 2. NAUTILUS, f. ind., ex aff. N. mesodici., p. 122. Chambered cast. From the Halorites Limestone of the Bambanag Section.

PLEURONAUTILUS.

„ 3. PLEURONAUTILUS TIBETICUS, E. v. Mojs., p. 120. Calcified chambered cast, with some portions of the test. From the lower Daonella beds of the Bambanag Section.

ATRACTITES.

„ 4. ATRACTITES, ind., p. 126. Fragment of a phragmocone, with part of the test; *a*, ventral aspect, *b*, posterior septum, seen from below. From the Halorites Limestone of the Bambanag Section.

ORTHOCERAS.

„ 5. ORTHOCERAS, f. ind., p. 126. Cast, with the body-chamber. From the Halorites Limestone of the Bambanag Section.

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Pl. XXI.

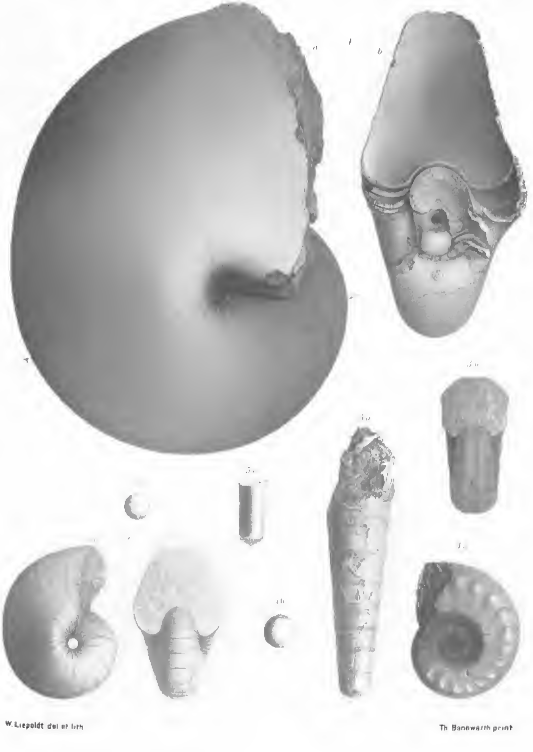

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PLATE XXII.

Clydonautilus.

Fig. 1. Clydonautilus Griesbachi, E. v. Mojs., p. 123. Chambered cast. From the limestone with Pinacoceras cf. imperator (No. 6) of the Bambanag Section.

Clydonautilus biangularis, E. v. Mojs., p. 124.

„ 2. Chambered cast. From the Halorites Limestone of the Bambanag Section.

„ 3. Example of a cast, with the body-chamber and portions of the test. From the same locality.

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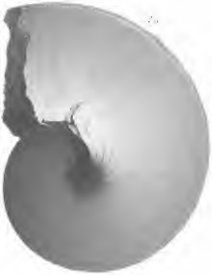

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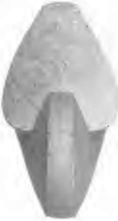

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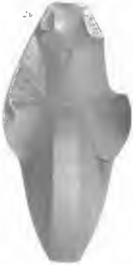

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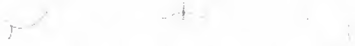

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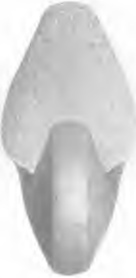

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